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THE HUNGARIAN MILLENNIUM

WHILE the programme of the fetes connected with the coronation of the Czar—which ended with the sad catastrophe of Khodynsky—was being carried out at Moscow, Budapest was organizing a fete which, although perhaps not as imposing, was not less brilliant. Five hours of railroad travel brings us from Moscow, queen of the vast steppes, to Budapest, sultana lying at the foot of the mountains and on the bank of the river. *There* in the Russian capital, an immense city of low houses grouped around oriental palaces and Byzantine churches, we witnessed the apotheosis of a man, the absolute master of a people. At Budapest, built of red marble and granite, the fete is not intended for the honor of one man, nor of several men; it is—besides being a national industrial and trade exhibition—for the celebration, by a free people, of the thousandth anniversary of the conquest by which they won their country

The National Hungarian Exposition moves on with great animation, is most instructive and amusing, and has many visitors. The grounds are crossed by many little electric tramways, the air vibrates with Tzigane music and Austro-Hungarian gayety, which is heightened, according to tradition, by a "Street in Cairo," which is here called "Old Buda under Turkish rule."

The real celebration of the millennial of Hungary took place between June 5 and 8. On June 5, the insignia of Hungarian royalty, the Sacred Crown—given in the year 1000 by Pope Sylvester II to Prince Etienne, and after Mathias the Just surmounted by a cross—the purple robe, the mound and the scepter, were carried from the royal palace to the church of Mathias Corvin, where they were exposed to view for three hours.

THE HUNGARIAN MILLENNIUM—CARRYING THE ROYAL CROWN TO THE NEW PARLIAMENT BUILDING.

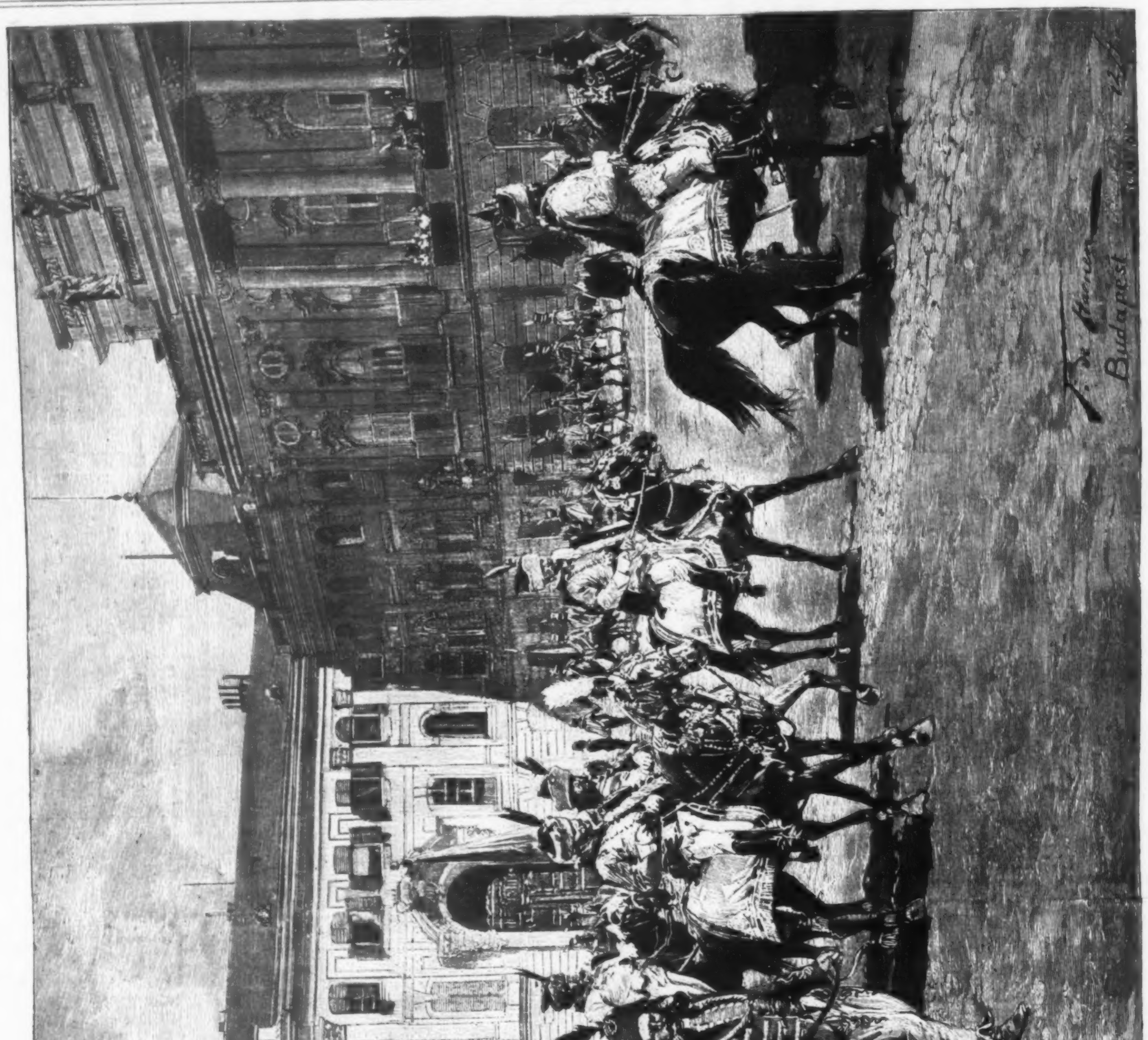
On June 8, Buda and Pesth presented, from the earliest hours, the aspect of capitals which had risen early to prepare for a great solemnity. The decorated streets, at the corners of which tribunes were erected, were crowded with people hastening in all directions, and in the sister cities sumptuous corteges were seeking their proper places. On all sides were delegations carrying banners, and detachments of soldiers with tufts of oak leaves in their hats, arriving and forming in line.

In front of the royal palace in Buda and the new building of the Hungarian Parliament the crowd was most compact, and the grand stands received numerous privileged guests. The passing of the procession before the King, Francis Joseph, and the solemn celebration of the millennial in the new palace were the main features of the day's fete.

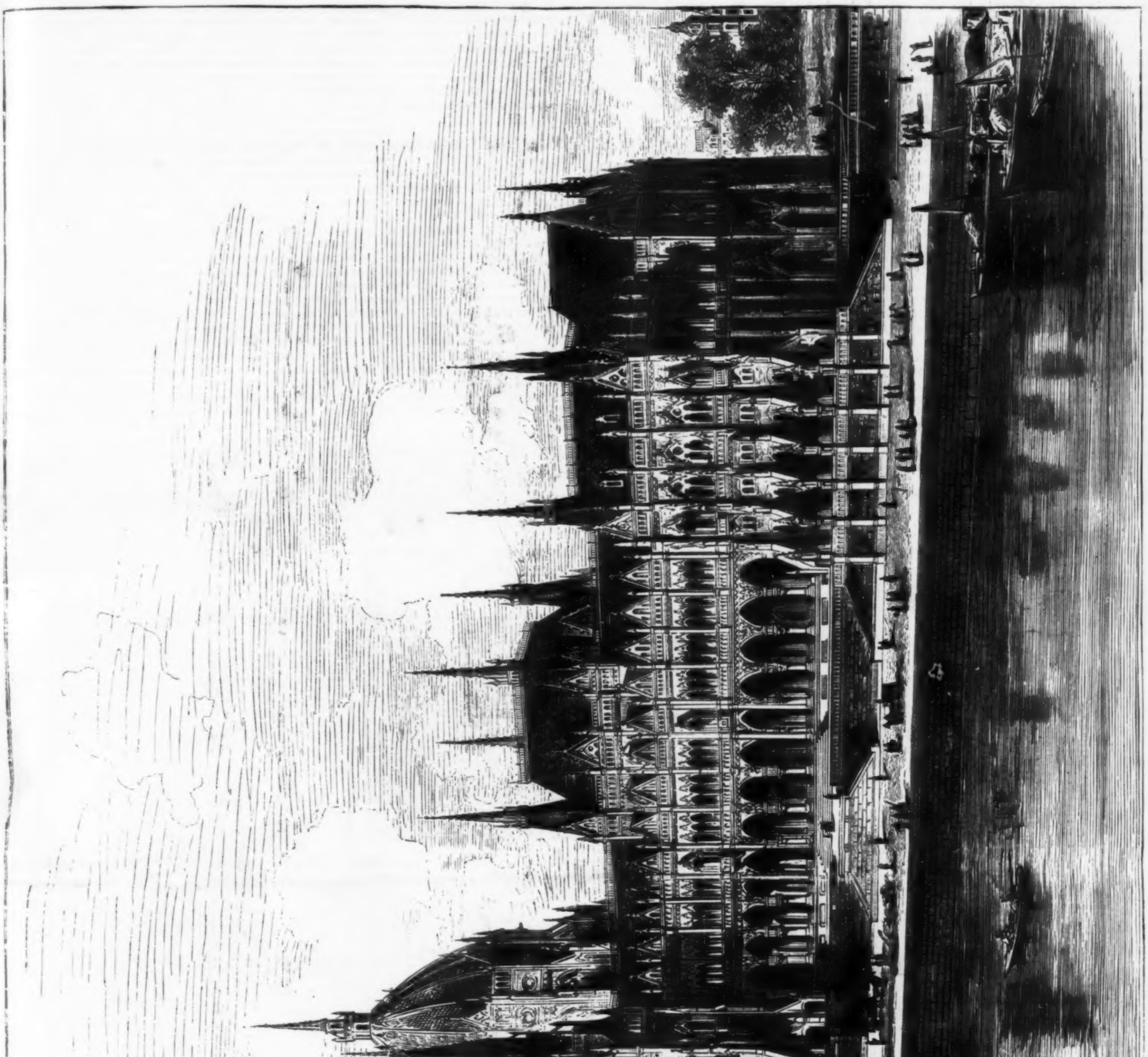
The cortege was formed on the Champ-de-Mars, and passed up to the palace in Buda by the serpentine road which is not yet completed, and from there went to the church of Mathias Corvin, crossing the Danube by the Marguerite Bridge. A little before ten o'clock it reached the square on which the Parliament Building stands.

This is an immense Neogothic structure facing the Danube; it is 885 feet long and covers about 21,528 square yards of ground. The height of the vanes that surmount the towers is 274 feet above the low water mark of the Danube, and the summit of the central dome is 351 feet high. The roofs of the Parliamentary Halls are discernible on each side of the dome, below which lies the immense gala hall intended for solemn celebrations, like the millennial, in which the two legislative bodies, the magnates and the deputies participate.

THE HUNGARIAN MILLENNIAL CELEBRATION—INAUGURATION OF THE NEW PARLIAMENT BUILDINGS.



THE HUNGARIAN MILLENNIAL CELEBRATION—PROCESSION REVIEWED BY THE EMPEROR FRANCIS JOSEPH.



THE NEW PARLIAMENT HOUSE, BUDA-PESTH, HUNGARY.—EMMERICH STEINDL, ARCHITECT.

THE HUNGARIAN MILLENNIAL CELEBRATION—PROCESSION REVIEWED BY THE EMPEROR FRANCIS JOSEPH.

The cavalcade, brilliant in the sun, passed slowly before the main entrance in the center of the façade facing the river and the city. The deputation on horseback from the city of Budapest came first, preceded by the Minister of the Interior, M. Désiré Perczel, in a costume of sky-blue velvet. Each of the 89 departments or counties, each of the autonomous cities of Hungary and Croatia, was represented, as was Budapest, by a banderium, a group of horsemen. A herald and a flag bearer preceded the group, and pages in blond wigs and costumes in the colors of the county or city led the horses by their bridles. Cities and counties display historic flags, some of which date from the crusades; the group from the County of Saros was preceded by the standard of Rakoczy.

This first part of the cortege included not less than a thousand horsemen. The picturesque richness, rather theatrical, the infinite variety of the Magyar costumes, the horses, trappings in the same style, dazzled the eyes and seemed a splendid anachronism in that modern city. Some of the men in the groups were dressed in coats of mail, with helmets; other horsemen had leopard or panther skins thrown across their shoulders. It is impossible to give a description of the whole, the attempt would end in the production of a thousand different descriptions. Trappings and costumes were covered with gems and enameled and chased jewels.

Magnates and deputies came next, in costumes even more opulent, and behind them were eleven flag bearers preceding the official carriages, the first of which, drawn by six snow white stallions, carried the emblems of Hungarian royalty. Those which followed were filled with dignitaries, prelates and high personages of the kingdom.

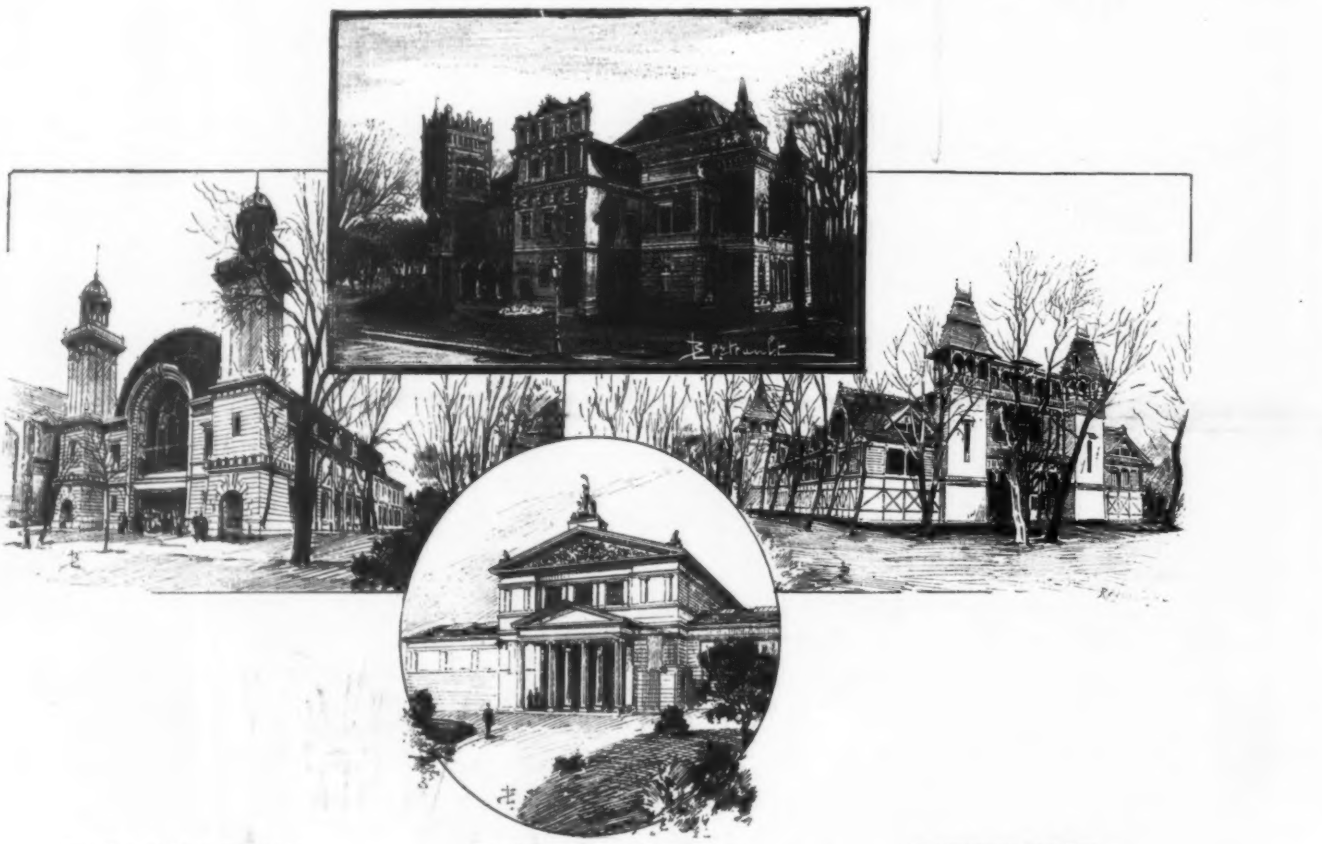
The eljen sounded when the bearers of the crown, Baron Nikolics and M. De Klobusitsky, preceded by Count Eugene Zichy and M. Szluah bearing the royal robe, and Counts Pangracz and Majlath, bearers of the mound and the scepter, ascended the steps of the Parliament Building between a double line of guards armed with pikes.

The bearers of the banners and insignia passed up the imposing grand marble staircase to the hall under the dome, where the two Hungarian chambers had already assembled. There were no seats except for the presidents and their assesseurs, and, in the tribunes, for the archduchesses (the Archduchess Stephanie is of the highest rank), the archdukes and diplomatic corps. M. Désiré Szilagyi, President of the Chamber of Deputies, and Count Tiburce Karolyi, Vice President of the Chamber of Magnates, occupied the presidential chairs, behind which, on a pedestal, on cushions of purple velvet, were placed the crown of St. Etienne and the other royal emblems. Short discourses, long acclamations, and the function was over. It was short, but its date has been inscribed forever in the history of Hungary.

An hour later all the cortege, horsemen and flags, magnates and deputies, ministers and dignitaries on horseback and in c rriages, returned to the royal palace. The King, Francis Joseph, was on the balcony, and near him, in her dress of mourning, was the Empress of Austria, Queen of Hungary. The banner bearers salute the sovereigns, the cities and counties thus renewing their oath of allegiance given to Arpad a thousand years ago by their victorious ancestors. Then the royal insignia were returned to the palace and sealed in the caskets from which they had been taken three hours before.

Although less military, less majestically pompous, than the corteges at Moscow, the cavalcade of Budapest appeared more picturesque, being conducted with less discipline and more freedom. At Moscow the celebration reminded one of Versailles under Louis XIV, while in the Hungarian capital we received rather the impression of a fete under Louis Philippe, with less formality, but with the luxury and incomparable display due to the love of the Magyars for gems, velvet, plumes and aigrettes, furs (with the thermometer high), trappings and pawing horses.—L'Illustration.

Pavilion of Commerce and Finances.



Pavilion of State Railroads. Pavilion of Public Instruction. Agricultural Pavilion.

THE HUNGARIAN MILLENNIUM—SOME OF THE EXPOSITION BUILDINGS.

OLEOMARGARINE AND WASTING DISEASES.

By G. ARCHIE STOCKWELL.

THE problem of nourishment in wasting diseases is perennial. In most instances the balance between waste and repair is greatly to the credit account of the former, despite all the resources of the medical art, direct or indirect, and whether adopted with a view to increasing nourishment or limiting elimination. Not the least of the problems that confront the practitioner is that of securing the full co-operation of the patient, for in sufferers of this class hope is constantly present, along with more or less disbelief of the conclusions drawn by the medical attendant. It is rare to find a consumptive who believes his vitality is already sapped or his life seriously in danger, and such a patient will insist upon yielding to the caprices of appetite, and upon assuming that he has plenty of time before him in which to decide regarding measures that, though vital, seem to him at the moment wearying or obnoxious.

With the first introduction of cod liver oil, it was believed that the problem of nourishment in wasting diseases was solved; and this agent to-day continues to be the favorite under the supposition that it offers the greatest possible results both to prescriber and patient, with a minimum of objectionable features. But there is nothing magical about this oil. Save as an easily digested form of fat, it is valueless, in spite of the many preparations of the so-called derivatives, active principles, glucosides, etc., that are offered to delude practitioner and patient, and which after all are only the ptomaines of decomposition. Again, cod liver oil is by no means the best form of fat, as has been shown on various occasions by Fothergill and others. There are few instances where the digestive organs will tolerate for any prolonged period a diet of this or any other unpleasant or pronouncedly flavored fat, despite the attempts of art to make it palatable. Indeed, nowhere is the truism of "one man's meat being another's poison" more apparent than when one assumes the management of wasting disease. And it may be mentioned here that mineral oils which are sometimes recommended as substitutes are utterly devoid of even the semblance of nutritious properties, while vegetable fats generally are very inferior to those derived from animal sources.

Fothergill expresses a most sensible preference for natural food fats—butter, fat pork, suet, etc.; and the benefit that consumptives often derive from winter residences in lumber camps is not due so much to the boasted balsamic air as to the capacity that is thereby developed for consuming and digesting enormous quantities of hydrocarbons. This fact is often lost sight of by medical men, who recommend their consumptive patients to spend their winters in the mild or enervating climate of the tropics or subtropics.

In everyday life butter is very essential. It is not regarded with the loathing that accrues to an article of food that is popularly classed among medicaments, and consequently its free use by sufferers from wasting disease is to be encouraged to the utmost in so far as it can be borne. All this seems very simple, but unfortunately an excess of butter diet, even in a healthy organism, is apt to give rise to butyric dyspepsia, developing the unpleasant concomitants that accrue through so-called water brash, pyrosis, heartburn, etc., and butyric fermentation is set up largely through the presence of a ferment—a residuum left by the buttermilk—which should theoretically be absent, but in practice it is impossible wholly to eradicate. This latent (lactic) ferment is the cause of decomposition—frowiness, etc.—in butter, and thus renders the products of the best dairies deficient from a digestive standpoint. Excessive washing, moulding and mixing is always an injury to butter, inasmuch as it results in disarrangement of the relations and proportions between oleic and margaric acids, and often—as with creamery products—gives a salve-like appearance and consistency not at all conducive to appetite.

Considering the foregoing, it seems trange that oleomargarine has not been thought of as a palatable and suitable article of diet for those suffering from wasting disease. It is free from all objections, despite the idle and malicious tales industriously spread by parties interested in securing high prices for inferior and unwholesome dairy products. Were the truth fully realized by all classes, bad butter would find no market, but, unfortunately, the majority of the people have no comprehensive idea as to what oleomargarine practically is.

Mége-Mouries, the official chemist under the late French empire, with a view of giving the poor and seafaring people an article that would be wholesome, nutritious, cheap and at the same time capable of being kept for unlimited periods of time, while working at the imperial farm at Vincennes sought to imitate the process supposed to take place in the bovine economy when cows are underfed and the butter furnished is derived from their own fat. The process he invented is to all practical purposes the same as that which is employed to-day.

First, the very best quality of fresh suet finely comminuted is placed in a steam heated tank along with a small amount of bicarbonate of potash and the stomachs of sheep or pigs, and retained at a temperature of 132° F. for two hours or more, or until the stomachs have succeeded in dissolving the fat membranes, and the fat itself has risen to the top.

Second, the fat is drawn into another tank and two per cent. of salt added, while it is maintained at a slightly higher temperature, and now, after a short time the fat becomes clear, takes on a yellow color and presents both the taste and odor of fresh butter.

Third, the fat is again drawn off, and after cooling cut in pieces, wrapped in linen and placed in a hydraulic press at a temperature of 177° F., whereby it is separated into two portions—stearine and oleomargarine. The former goes to the candle makers; the latter is artificial butter theoretically and chemically. Of course different manufacturers vary the process to individual ideas and needs, and some use pepsin direct instead of obtaining it through the medium of animal stomachs; nevertheless, the principle is the same on all occasions.

The resulting product, as a matter of fact, is a better and purer butter than nine-tenths of the dairy product that is marketed, and one that is far more easily preserved. No one, however expert, can detect the difference between "oleo" and the best dairy butter, except perhaps after a long diet of the former he may suspect the latter, owing to the faint acid flavor due to the lactic ferment that properly should have been removed. To be sure, everyone imagines it possible to detect between "oleo" and dairy butter by taste alone, but in truth differentiation is very hard to accomplish

by any process, even by the expert chemist, with all the most elaborate laboratory means at his disposal.

There are a large number also who imagine oleomargarine is made from any old scraps of grease, regardless of age or cleanliness, which is quite the reverse of fact; indeed, a good "oleo" can only be had by employing the very best and freshest of fat. This "artificial butter" is as purely wholesome (and perhaps even better as food) as the best dairy or creamery product. Some, while the "oleo" is fluid and at high temperature, with a view to improving flavor, add milk, water and salad oil. In any event, it is imperative upon the manufacturer that the greatest hygienic precautions be constantly employed. Consequently artificial butter or "oleo" is not only, as just remarked, equal to genuine butter in flavor and fully as nutritious, but greatly superior to the latter in being freed from lactic acid, whereby it is less liable to become rancid and form a harboring place for bacteria.

Recently Jollies and Winkler, who are the official chemists for the Austrian government, after a very thorough investigation, announced, through the columns of the Zeitschrift fur Hygiene, that the only germs ever present in "oleo" are the varieties common to air and water. Although carefully sought for, tubercular bacilli and other obnoxious bacilli were conspicuously absent. They also found that the dairy product is especially liable to be contaminated, inasmuch as the best process of manufacture failed to eliminate all the lactic acid ferment, the action of which even salt cannot neutralize, save for a very brief period.

It may also be added that the greatest producers of "oleo" are also the greatest individual consumers thereof, for the reason—as one expressed himself to the writer—they "know what is being eaten, and have the assurance that it is always thoroughly cleanly"—an assurance that can never be depended upon regarding any dairy product.

"Dairy butterine" so called is only the attractive title given to an "oleo" put up neatly in rolls in a gauze envelope. There is, however, a cheap product denominated "butterine," sold at a much less rate than true "oleo," which is merely a mixture of the latter and neutral lard; even this, if made from strictly fresh materials, is not necessarily objectionable. Those products denominated oleomargarine, butterine, etc., which are of rank character, do not emanate from reputable factories, which are invariably connected with beef packing houses, but from petty manufacturers who accept fats of all kinds that are rejected by the regular oleomargarine makers. The very fact that an "oleo" offered is devoid of unpleasant odor or flavor is evidence sufficient that it is a genuine article and made only of the freshest and purest fat. Another thing regarding "oleo" is that from the time the fat is placed in the melting vat until it is laid before the consumer as an artificial butter—the adjective artificial though generally used is certainly superfluous, from a chemical standpoint at least—the entire process is one of the greatest cleanliness, and the product is never by any means allowed to have the taint of human hands, and for market purposes is further protected by an envelope. Finally, it may be added, a large portion of the material at the present time marketed as pure butter, and emanating from country dairies and creameries, is but a mixture of cheap "oleo" and dairy butter.

It is surprising the amount of fat that a consumptive finds it possible to consume when employing "oleo" instead of butter, and it is by no means essential that the individual shall be informed that the product of the packing house is not derived from the dairy if he is likely to have any prejudices in this respect.

JULES SIMON.

WE present an engraving of the eminent French scholar and statesman Jules Simon, who died on June 8. For this engraving we are indebted to L'Illustration.

Jules Simon was born at Lorient, December 31, 1814. His parental name was Suisse, but he adopted that of Simon, and is known by no other, says the New York Tribune. He was educated at a college in Lorient, and afterward at another in Vannes, and subsequently became an assistant teacher in the college at Rennes, and in the normal school for primary teachers there.

Graduating in philosophy, he was assigned to the chair of that science in the Lycée of Caen, and in the following year at that of Versailles. He was then called to Paris by M. Victor Cousin, who secured for him a professor's place in the Normal School Superior as assistant lecturer on the history of philosophy. He succeeded M. Cousin in 1839, upon the recommendation of the latter, in the chair of philosophy at the Sorbonne, and became exceedingly popular as a lecturer. For a dozen years he gave the philosophical department there some of the brilliancy it had under Cousin. He paid, however, great attention to politics, for which he had a particular taste and ability.

In 1846 he was the candidate of the Moderate Opposition in the Department of the Cotes du Nord, attacking the Guizot ministry with great vigor, and promulgating strong popular views. He was defeated, partly through the influence of the Clerical party and somewhat through distrust created by his position as a state functionary.

In 1847 he established, with several of his university colleagues, a political and philosophical review, called "The Liberty of Thought." The politics of this periodical was under his particular care. He became in 1848 a member of the Constituent Assembly for the Cotes du Nord, which had formerly rejected him, receiving over 65,000 votes.

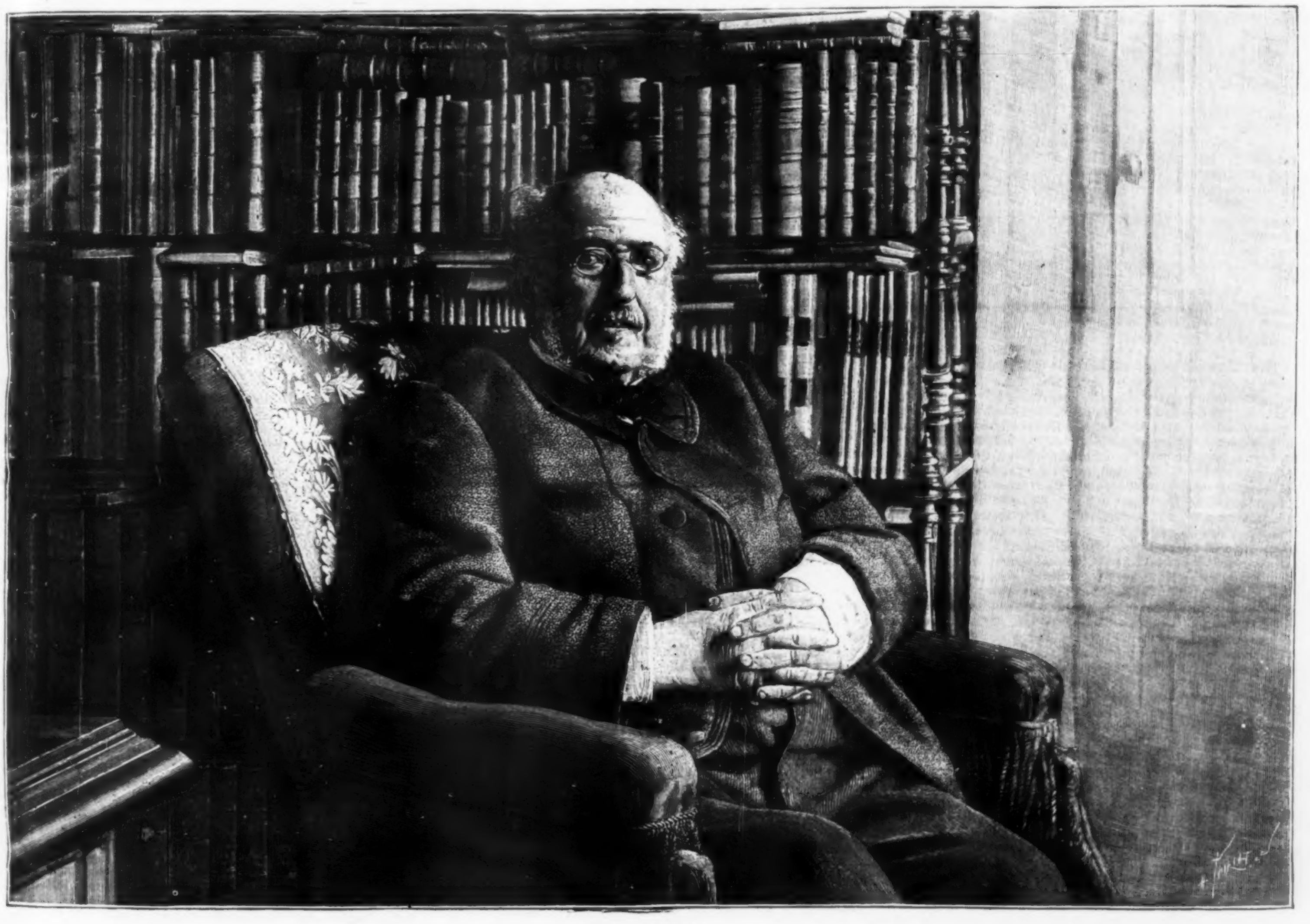
During the stormy days of June, 1848, M. Simon distinguished himself as a conciliator of the infuriated population. He entered the disaffected quarters of Paris, went behind the barricades, and fairly risked his life in his effort to restore peace. When Louis Napoleon was a candidate for the presidency, M. Simon was one of the warmest of his opponents, having become a member of the staff of "The National." He was nominated for a place in the Council of State, but was rejected by the legislative assembly.

The coup d'etat marked a crisis in his life. Up to that time he had been an independent in politics, though with republican leanings. Louis Napoleon was anxious now to have him join the imperial party, and offered him the strongest possible temptations to do so. At the Sorbonne he spoke most plainly and scathingly against the outrage upon liberty which had been consummated, and his lectures were suppressed by a special decree in consequence. M. Simon had no private fortune, and his political honesty compelled him to begin the battle of his life over again. Then, finding all lecture rooms in France closed to him, he started in 1855 on a round of "conferences" in Belgium, and everywhere—at Liege, Gand, Bruges and Brussels—was listened to with the deepest interest.

He returned to France in 1861, to establish a number of model lodging houses for working people, with money that had been contributed for that purpose.

In 1863 he was elected to the legislative body, to which he was warmly welcomed by the Liberal deputies. He had already been unsuccessful as a candidate in Paris in 1857. His first speech in the legislature was made on January 19, 1864. He became a marked member as the champion of popular education, of free trade, of the abolition of the death penalty, of the interests of the workingman, and the interests of the women of the working classes.

In the general election of May, 1869, Jules Simon was a candidate for re-election in a large number of departments, but especially in the eighth division of the Seine and in the Gironde. On his re-entrance into the Chamber he steadily gained in public esteem as an orator. Without abandoning the discussion of great political questions, he gave more attention to economic subjects, brought up by the restoration to the legislative body of the right to settle treaties of commerce.



JULES SIMON.

M. Simon was an energetic opponent, with the Left, of the declaration of war against Prussia.

After the revolution of September 4, 1870, M. Simon found himself proclaimed a member of the Government of National Defense. On the fifth he was named Minister of Public Instruction.

In 1871 M. Simon was elected to the National Assembly for the Department of the Marne, receiving over 31,000 votes. He became Minister of Education and Public Worship under M. Thiers, and retired with that statesmen in 1873, retaining, however, his seat in the National Assembly. While he was in charge of the Department of Public Instruction he instituted great reforms.

The condition of the national museums occupied much of his attention. In 1875 he received from the government a pension of 6,000 francs. The same year he was elected a life senator.

M. Simon's work outside of his legislative activity has been concerned chiefly with the advance of primary education and the improvement of the condition of the working classes.

His work as a journalist has been incessant.

M. Simon was elected in 1875 a member of the Academy, to succeed Remusat. He was permanent secretary of the latter body. The enormous number of books published by M. Simon indicates the versatility of his mind, and all certify to his independence and elevation of thought and the excellence of his literary style.

ENGINEERING NOTES.

Russia has just launched its largest armored cruiser, the Russia, the longest vessel ever launched on the Neva. She is 464 feet long between perpendiculars, measures 12,195 tons, and is second only to the very latest English ships, the Powerful and Terrible. Her engines are of 17,000 horse power, and her speed is intended to be 19 knots. The armor plates for her belt were made at the Carnegie works. On the same day the 4,000 ton coast defense ship General Apraxin was launched.

Experiments recently made by the Royal Society of Belgium in connection with the welding of metallic bodies by simple pressure at heats below their fusing points have demonstrated the fact that the most perfect joints are obtained with gold, lead and tin, and the weakest with bismuth and antimony. In the course of the experiments cylinders of pure metal with smooth surfaces were brought together by a handscrew and kept at a temperature of between 200° and 400° for from 3 to 12 hours. When separated the break in no case corresponded with the jointed surfaces.

Compressed air is being largely used at the Pullman Car Company's works for power transmission in place of the belting formerly used. It is interesting in this connection to recall the fact that power transmission by means of air was largely adopted at the Soho Works of Messrs. Boulton & Watt, the best part of a century ago, but in this case vacuum motors were used, and consequently the same compactness of plant was not obtainable as when compressed air is used. Messrs. Easton & Anderson (now Messrs. Easton, Anderson & Goolden, Limited) also many years ago extensively adopted the use of compressed air for driving steam hammers, punching and shearing machines, etc., at their works at Erith.

In the United States, during the year 1895, occurred 355 boiler explosions. This is the number tabulated by the Locomotive, and is probably short of the true number. By these explosions 374 people were killed and 519 injured. The property loss is not stated. In the preceding year the number of explosions was 361, and in 1893, 316. Inspection of boilers and examination of engineers is not general, and even where the law requires both, politics is an ever potent factor. So long as inspection fails to inspect, so long will carelessness and ignorance continue the work of destruction, ably supported by the shortsighted economy of a large percentage of plant owners. Time will press home the importance of inspection and supervision, no doubt of it, but meantime the sacrifice of life and property will continue.

The United Service Gazette (British) says that in view of the recent large increase of the fleet the Admiralty has completed arrangements for greatly augmenting the number of stokers and engine room artificers. Last year there were 17,095 of those ratings. It is proposed to raise this total by 3,028. The engine room artificers will be increased by 266, which, together with the entries necessary to fill vacancies caused by ordinary wastage, will necessitate a total entry of 339. Of this number it is proposed to enter 44 at the Portsmouth Reserve, 152 at Devonport and 143 for the Medway Reserve. The number of stokers, of all grades, will be increased by 1,762, but in consequence of an estimated wastage of 1,000 a total entry of 2,762 will be made. The stokers will be entered at the depot ports in the following proportion: Portsmouth, 1,396; Devonport, 688; Chatham and Sheerness, 676. The total cost of this addition to the engine room department will be £88,704, the wages for these ratings this year being estimated at £877,765, against £789,061 for 1895–96.

It is rather a happy thought by the management of one of the Pennsylvania Railroad Company's lines, says the Railway Age, to offer the prize of an annual pass to the farmer who will do the most in a given time to beautify his grounds along the railway. All the efforts of the superintendent to make his right of way attractive are often neutralized by the slovenly looks of the farmyards through which the road runs, and if the possibility of securing an annual pass—a greater prize than much money, in the eyes of most men—shall cause a general improvement in appearances all along the line, the entire community will be benefited, while the enjoyment of travelers will be much enhanced. The selection of the single prize winner out of probably a hundred or more competitors will prove a delicate task, perhaps involving the peace of whole counties, but those who fail to win should console themselves by the fact that their united exertions have improved the appearance and increased the reputation of their region and that they have really been working for their own benefit much more than for that of the railway.

In a paper in the Journal of the American Chemical Society, on "Coals, Determination of their Heating Effects," by W. A. Noyes, J. R. McTaggart, and H. W. Craven, references are given to the recorded discrepancies found by Scheurer-Kestner and others to exist between the calculated and the determined calorific powers of coals. The authors have tested six specimens of representative Indiana coals by the Hempel calorimeter, by Berthier's test, and by analysis; two of these coals—Brazil and Lancaster—are non-caking, and are known as block coals, while the other four are bituminous caking coals. Anthracite could not be compressed into cylinders for the calorimeter, and could not be burned as a powder. It was therefore not tested. The moisture was found by drying at 105 degrees Centigrade for an hour in a toluene bath, and the fixed carbon by heating one gramme of the coal in a covered platinum crucible with the full flame of a Bunsen burner for seven minutes. The oxygen was estimated by difference, after adding to the weight of ash found, five-eighths of the weight of sulphur present, as the sulphur generally occurs in the form of pyrites, which is assumed to be burned to Fe_2O_3 and SO_2. The calorific power is calculated from the formula $8080\,C + 28{,}800\,(H - \frac{1}{8}O) + 1582\,Fe + 2168\,S$, the symbols standing for the weight of the corresponding element present, and hydrogen being supposed burnt to vapor of water.

ELECTRICAL NOTES.

Chicago consulting electrical engineers are trying to form an organization for the purpose of establishing a uniform schedule of fees, and for the mutual enforcement of a stringent code of professional ethics. The movement is well supported, and the outcome is expected to be an association of strictly professional men, who will not compete on a commercial and financial basis.

It is reported, says the Electrical World, that the United Press furnished to every newspaper supplied with its service in the United States the announcement that Persimmon had won the Derby at Epsom Downs before the winner had ceased his galloping stride and a blanket had been thrown over him. The first letters of the word Persimmon were received in New York before the transmission of the full word had been accomplished by the operator at Epsom Downs.

The Railway Review says that a rail was melted by an electric current recently on a plate girder bridge carrying the New York, New Haven and Hartford Railroad over Mount Hope Street, in North Attleboro, Mass. An electric railway passes under the bridge, but the headway is so limited that the trolley wire is not carried under, but has its ends anchored by three guy wires to the plate girders, the car running under the bridge by its own impetus. Each guy wire has a glass insulator, but one of these was broken, and the current leaked along the wire to the girder and along one of the cross girders, the top of which was only about ¾ inch below the base of the rail. Rain and an accumulation of cinders facilitated the formation of an arc, and the rail base was melted away until in one place it was only 2½ inches wide. The corrosion was discovered before the passage of the morning train, or a serious derailment might have occurred.

In their investigations into the possibility of transforming carbon into graphite, MM. Girard and Street have devised several modifications of the electric furnace. These, together with the results of their experiments, form the subject of a paper in L'Eclairage Electrique, iv, page 454, and there is an abstract of the paper in the "Proceedings" of the Institute of Civil Engineers, cxxiii, page 78. The furnace consists of the usual block of refractory material, through which passes vertically into an inner cavity the rod of carbon to be converted into graphite, and another rod to meet it at right angles. At the junction, of course, an arc is maintained. The first carbon passes into the furnace at a speed which depends upon the temperature of the furnace. In the case of carbons for arc lighting, the rod is also given a rotary movement as well as a translatory movement. The effect is stated to be as follows: The effect of the arc is to leave a spiral trace on the carbon to be converted, this tracing indicating the path of the conversion into graphite. Obviously, the whole surface of the carbon can thus be graphitized. The Electrical Review says the result upon the physical properties of the carbon is that both the conductivity for heat and that for electricity is increased fourfold, while the density is also enhanced—these being advantages by no means to be despised.

An electric process of converting emery into corundum by means of the alternate current are has recently been patented. As heat, and not decomposition, is aimed at, continuous currents would be unsuitable. This furnace is made of firebricks and stands on two bridges; the hollow underneath serves as a receptacle for the fused mass, there being a small hole in the bottom of the furnace. This hole is covered with a glass plate. The electrodes—carbon rods—are approached to within 1 in. to 2 in., the space between being packed with lumps of carbon. The emery, the finest dust, of little use otherwise, is mixed with powdered coal, the amount depending upon the iron oxide in the emery; for 25 per cent. of oxide 5 per cent. of carbon is reckoned. The coal is soon burned by the oxygen of the iron oxide and the arc forms. The inner mass begins to melt, the glass plate gives way, and a stream of fused corundum flows out. The hard outer crust is then broken with iron rods, and new material thus fed to the arc. This addition stops the flow, which starts again after ten or fifteen minutes. The baseplate is strewn with fine emery powder to protect it from the intense heat of the fused mass. The resulting corundum is almost free of water, of which the emery contains about 5 per cent. It is crystalline, colorless, and then resembling quartz; pink or blue, fine, small crystals of sapphires have been found in druses. The current is kept at 250 amperes and the pressure is 40 or 60 volts.

Contracts have been closed to furnish motors for the car equipment of the Columbia and Maryland Railway Company, the boulevard road which is to connect Baltimore and Washington. Ten equipments of two 30 horse power motors each, twenty motors in all, are for the cars which will run between Baltimore and Catonsville. For the through cars the contracts call for eight sets of four 100 horse power motors, or thirty-two in all. These are to be put on a car, and are to be guaranteed to maintain a continuous speed of sixty miles an hour on a level track. The through cars will be 48 ft. long, and will be run in trains, with a total weight of forty tons, to be drawn by the four motors. With the attainment of high speed comes the problem of getting a trolley which will stick to the trolley wire. One plan of overhead construction now being considered for the road is to have the trolley wire suspended by "hangers" at intervals of 20 ft. from a suspension wire running parallel with it. The suspension wire would be far enough above the trolley wire to keep the cross wires from the poles out of reach of the trolley pole, should it slip off and fly up in the air while the car is traveling at a high rate of speed. Another plan, and the one likely to be adopted, is for a similar construction to that used in the belt tunnel, Baltimore. This is a sort of trough, through which runs a metal shoe that takes up the current and transmits it to the car motors through a flexible connecting cable. The advantages of this are freedom from danger of the trolley leaving the source of supply of the electric current, and the fact that the connections are protected from the elements and incur no danger of becoming coated with ice in winter storms, as the case with the ordinary trolley wire.

MISCELLANEOUS NOTES.

Ballooning, for many years past a favorite study among French officers, is not popular in the British army. A class for instruction at Aldershot had to be given up, owing to the lack of volunteers.

After a series of trials of Commander J. D'Arcy Irwine's line-throwing gun, the Trinity House Corporation have ordered five of their steam vessels to be supplied with these guns. The object of the new gun is to effect immediate line communication between ship and ship at sea, or between ship and shore, by means of a rod having a line attached to it. Another use claimed for the gun is for effecting the saving of life from drowning.

During 1895 the Compagnie Générale des Voitures à Paris had 2,606 cabs in use. The gross receipts were 15,311,835 fr. 67 c., and the expenses 14,695,848 fr. 95 c., of which 2,149,279 fr. 27 c. consisted of rates and taxes. So that the net profit was 615,996 fr. 72 c. If this net profit be divided by 2,606 (the number of cabs in use), it will be seen that the average profit per cab per annum was 236 fr. 37 c., or only 65 centimes per day. —Westminster Gazette.

In Austria drunkards are treated under the curatel law, that applies to persons mentally afflicted and to spendthrifts, their affairs being placed in charge of an administrator. A person suffering from excessive indulgence in drink may be brought judicially under this law. But in Gallacia, Cracow, and Bukowina there are special laws for the punishment of persons drunk in public places, while persons convicted of drunkenness three times in one year are prohibited from visiting public houses. A bill has been introduced in the Austrian Reichsrath providing for the erection of public asylums for drunkards, who may be detained for two years on complaint of their relatives or of the public authorities.

Some experiments have been carried out at Portsmouth, England, with a new night signaling apparatus, the invention of a Capt. Seilner, an officer in the Austrian navy. The signaling is carried out with two lanterns, on either of which five different arrangements of red and white lights can be shown, the two together being able to show no less than thirty different combinations. Electric lights are used for the lanterns, and though separate batteries are used for the lights and for the signaling apparatus by which the lights are changed and obscured at will, eventually it is intended that one dynamo shall be so arranged as to supply all the current required. A check on signals sent by the apparatus is obtained by a device by which the message sent is automatically printed by the working of the signals. It was found that no difficulty was experienced in reading the signals at a distance of six miles and more.

A recent author shows, says the Independent, that a prevalent notion that the Japan ivy and similar plants which cling to the wall by rootlets make the walls damp, is the reverse of the fact. Tons of water are evaporated daily from these leaves in the growing season—an amount which it is almost impossible they could draw from the earth through stems which at the ground are seldom thicker than one's finger. The rootlets suck water from walls to help supply this waste; besides this they cool walls by their shade in summer. The action of the famous English ivy on ruins is referred to as practical proof of the drying character of these rootlets; the mortar is so hard and dry that it is difficult to demolish these old walls. If the branches are allowed to get into gutters or other water conduits, so as to choke the flow in heavy rains, it is said the walls may be rendered damp; but not by the mere clinging to the walls of the plants themselves.

Coal oil as a substitute for flushing by water in public urinals has proved highly successful after three years' trial in Paris, Vienna and Berlin. The clinging of offensive matter to the stone or cement walls is prevented by making a fatty substance soak into the stone. The stone work is first thoroughly cleansed with a solution of hydrochloric acid in water, then dried, and coal or other mineral oils applied with a whitewash brush. With a renewed application of oil only once in two months the place can be kept perfectly sweet and clean. In practice, however, in all three cities, oil is applied every morning. The cost in two large institutions in France has proved to be very slight. At the Marine School at Bordeaux $5.50 of oil was used in three years, while at the Rambouillet infantry school $4 of oil sufficed for a year. This is out of all proportion to the cost of water for flushing in the same time. There seems to be no danger of the pipes freezing, for the urinals of Berlin open to the air have been exposed to a temperature of zero Fahrenheit.

There are over 80,000 houses in Paris, and each one has its majordomo in the shape of a concierge, who is as vigilant as Cerberus in his watch and ward over the mansion. This mortal usually knows more about your business than you do yourself. He becomes an awe-inspiring autocrat to the student wherever he may find his abiding perch. The concierge knows the financial condition of each lodger and is on the qui vive regarding gossip and scandal. There are all sorts and conditions of lodgings to be had in Paris. The cheapest is called "le cabinet," literally a mere cupboard with space only for a cot. The price of this bandbox is $24 per year. The best that can be said of it is that it is a shelter from wind and weather. The occupant is expected to live in the streets. Many a country lad has come to the metropolis and begun the battle of life in such a box. The next higher step toward comfort is the "chambre," which boasts a fireplace and a window. For these luxuries one pays anywhere from $30 to $50 a year. Next comes the "chambre-et cabinet" and the "lodgement," two rooms and kitchen with a fireplace and windows. The "petit apartment" begins the claims of gentility. An "apartment" embraces a whole suite and ranges in price from $100 upward. The high water mark of luxury is the private hotel, which answers to our handsome and luxurious private dwellings and mansions. In Paris a grand hotel always means a public house.—Boston Advertiser.

SELECTED FORMULÆ.

Metal Polishes.—

PETROLEUM BRASS POLISH.

Tripoli	16 oz. av.
Spanish whiting	16 "
Powdered rottenstone or pumice	8 "
Petroleum	2 fl. oz.
Petrolatum	to make a soft paste.
Oil myrbane	to suit.

POLISH FOR MACHINERY.

Levigated rottenstone	1 part.
Iron subcarbonate	3 parts.
Oil bitter almonds	to perfume.
Olive oil	to make a paste.

Or:

Oxalic acid	1 part.
Jewelers' rouge	15 parts.
Powdered rottenstone	20 "
Palm oil	60 "
Petrolatum	4 "

POLISH FOR STEEL.

Arsenious acid	1½ drachms.
Elutriated bloodstone	1½ "
Antimony trichloride	6 fluid drachms.
Alcohol (90 per cent.)	1 pint.

Digest at a gentle heat, shaking frequently.

POLISHING POWDER.

Magnesium carbonate	20 parts.
Calcium carbonate	20 "
Ferric oxide	35 "

—Merck's Report.

Gold and Bronze Paints.—The liquid employed with which to mix the bronze powders (which can be bought of all grades and shades of color) is, for ordinary indoor work, dextrine (400 g.), containing potassium bichromate (1 g.) and sufficient water. Use 65 g. of bronze powder. For more permanent work dilute water glass may be used. Borax shellac solution, mixed with one-third alcohol, also is used, something like this: bronze powder, 55 parts; alcohol, 10 parts; borax shellac solution, 25 parts. Or dissolve a dammar in benzol and neutralize with solution of potassa by shaking together and allowing to separate.—American Monthly Microscopical Journal.

Luminous Calcium Sulphide.—The compound designated as "luminous calcium sulphide" may be prepared in the following manner: Boil for one hour 2¼ ounces of caustic lime, recently prepared by calcining clean, white shells at a strong red heat, with one ounce of pure sulphur and one quart of soft water. Set aside in a covered vessel for a few days; then pour off the liquid, collect the clear, orange colored crystals which have been deposited, and let them drain and dry on bibulous paper. Place the dried sulphide in a clean graphite crucible provided with a cover, and heat for half an hour at a temperature just short of redness, then quickly for about fifteen minutes at a white heat. Remove the cover, and pack in clay until perfectly cold. A small quantity of pure calcium fluoride is generally added to the sulphide before heating it. Such preparations are, of course, difficult to prepare without a fully equipped laboratory.

Liquid Colored Fires.—These may be made by dissolving certain substances to saturation in alcohol or other liquids which dissolve them, and burn with rapidity. They are best ignited in a shallow iron pan, which for safety should be set in a shallow pan of water. The substances used should be finely powdered and triturated with the alcohol in a mortar. Blue may be made by dissolving zinc acetate in alcohol (green by dissolving boric acid in alcohol); red by dissolving strontium nitrate in alcohol, or by making a strong tincture of lycopodium; violet by dissolving potassium carbonate in alcohol; yellow by dissolving sodium nitrate in alcohol; white by dissolving camphor in alcohol. Another method of exhibiting colored fires, and perhaps the best of all, is to mix the finely powdered substances which produce the colors as above with a moderately thick solution of shellac in alcohol. They are thus suspended, and when burned give forth their characteristic color.—Drug Topics.

Medicated Gelatine Pencils.—The following basis and method is recommended by Montier for the preparation of gelatine crayons: 60 grammes of water and 10 grammes of glycerine are placed in an enameled dish, and the medicament dissolved in the liquid, which is heated to boiling; to the boiling solution 100 grammes of gelatine is added, with constant stirring to prevent its adhering to the bottom of the vessel. When the water is almost evaporated and the paste flows with difficulty in the capsule, it is run into suitable moulds of gun metal, or into glass tubes previously oiled. The author has devised an ingenious arrangement, in which the tubes are surrounded by a water bath, thus keeping the paste fluid until they are filled. The moulds are then cooled, and the mass withdrawn, trimmed and exposed to the air to dry for twenty-four hours.—Pharmaceutical Journal.

Lightning Paper.—A novelty in fireworks effects may be made by the use of lightning paper. This consists essentially of pyroxylin or gun paper, and is made by immersing unsized white paper (Swedish filter paper preferably) in a solution of nitric and sulphuric acids. First procure a flat dish, just large enough to hold the pieces of paper. Fill the dish three-quarters full with a solution composed of four parts (by measure) of sulphuric acid and five parts of nitric acid. Mix the two acids well by stirring with a glass rod, and when the mixture has cooled, take one of the sheets of paper, immerse it in the solution, and let it remain for ten minutes. Remove it by the aid of a glass rod, and place it in a large pan under a tap of running water, where it should be washed for about half an hour, or until every trace of acid is removed from the paper. After being dried the papers are immersed in solutions of different chlorates according to the color of fire desired. A saturated solution of strontium chlorate gives a crimson color; lithia, a beautiful rose pink; barium, green; copper, blue; potassium nitrate, violet. When small pellets of these papers are lighted at one point by a flame and then thrown into the air, a flame of intense colored light is produced, while the combustion is so perfect that there is no perceptible ash left.—American Druggist.

COLOR PHOTOGRAPHY.

THE scientific event of last week, says Nature, was the description and demonstration of color photography given by Professor Lippmann before the Royal Society. On the occasion of the centenary celebrations of the Institute of France last year. Lord Kelvin invited Professor Lippmann to give the Royal Society an account of his researches on photography in colors, and last Thursday's meeting was the result. The methods employed by Professor Lippmann are well known among men of science, but few of the Royal Society were prepared to see such remarkable results as those obtained and exhibited by the distinguished French physicist. The honor and fine feeling which such visits bring to the society, and the extreme interest aroused, should help to make similar occasions of more frequent occurrence. We print Professor Lippmann's lecture below, and our only regret is that it cannot give an at all adequate conception of the striking achievement with which it deals.

The problem of color photography is as old as photography itself. The desire of fixing the colors as well as the design of the beautiful image thrown on the screen of the camera very naturally occurred to the earliest observers. Since the beginning of this century three distinct solutions of the problem have been realized.

The first solution, not quite a complete one, is founded on the peculiar properties of a silver compound, the violet subchloride of silver. E. Becquerel (1860) converted the surface of a daguerreotype plate into this silver compound, and by projecting on it the image of the solar spectrum, and other objects, obtained good colored impressions. Poitevin substituted paper for the silver plate as a substratum. No other substance has been discovered that can play the part of the subchloride of silver. Moreover, the image is not fixed, in the photographic sense of the word; that is, the colored impression is retained for any length of time in the dark, but it is blotted out by the action of daylight. The reason of it is this: the Becquerel images are formed by colored silver compounds, which remain sensible to light; so that they are destroyed by the continued action of light in virtue of the same action which gave them birth. Despite the numerous experiments made by Becquerel, Poitevin, Zenther, and others, no substance has been found that is capable of destroying the sensibility of the subchloride for light without at the same time destroying its color.

The second method for color photography is an indirect one, and may be called the three color method. It was invented in France by Ch. Cros, and at the same time by M. Ducos du Hauron (1869). German authorities claim the priority of the idea for Baron Bonstetten. Three separate negatives (colorless) are taken of an object through three colored screens. From these three positives (equally colorless) are made; and, lastly, the color is supplied to these positives by means of aniline dyes or colored inks. Thus three colored monochromatic positives are obtained which by superposition give a colored image of the model. In the ingenious process lately invented by Professor Joly, the three negatives, and apparently the corresponding three positives, are obtained interwoven on one and the same plate. The three colored method can give a very good approximation to the truth, and has probably a great future before it. We may call it, nevertheless, an indirect method, since the colors are not generated by the action of light, but are later supplied by the application of aniline dyes or other pigments. Moreover, the choice of these pigments, as well as of the colored screens through which the negatives have been obtained, is in some degree an arbitrary choice.

The third and latest method by which color photography has been realized is the interferential method, which I published in 1891, and the results of which I beg to lay before you this evening. It gives fixed images, the colors of which are due to the direct action of the luminous rays.

For obtaining colored photographs by this method, only two conditions are to be fulfilled. We want (1) a transparent grainless photographic film of any kind, capable of giving a colorless fixed image by the usual means; and (2) we want a metallic mirror, placed in immediate contact with the film during the time of exposition.

A mirror is easily formed by means of mercury. The photographic plate being first inclosed in a camera slide, a quantity of mercury is allowed to flow in behind the plate from this small reservoir, which is connected with the slide by a piece of India rubber tubing.* The slide is then adapted to the camera, and the action of light allowed to take place. After exposure the slide is separated from the camera, the mercury reservoir lowered so as to allow the mercury to flow back into it; the photographic plate is then taken out, developed and fixed. When dry, and examined by reflected light, it appears brilliantly colored.

The sensitive film may be made either of chloride, iodide, or bromide of silver, contained in a substratum either of albumen, collodion, or gelatine. The corresponding developers, either acid or alkaline, have to be applied; the fixation may be cyanide or bromide of potassium. All these processes I have tried with success. For instance, the photograph of the electric spectrum now projected before your eyes has been made on a layer of gelatino-bromide of silver, developed with amidol, and fixed with cyanide of potassium.

As you see, bright color photographs may be obtained without changing the technique of ordinary photography; the same films, developers and fixators have to be employed; even the secondary operations of intensification and of isochromatization are made use of with full success. The presence of the mirror behind the film during exposure makes the whole difference. From a chemical point of view nothing is changed, the result being a deposit of reduced silver left in the film, a brownish, colorless deposit. And yet the presence of a mirror during exposure causes the colorless deposit to show bright colors. Of course we want to know how this is done; we require to understand the theory of those colors.

We all know that colorless soap water gives brilliant soap bubbles; the iridescence of mother-of-pearl takes birth in colorless carbonate of lime; the gorgeous hues of tropical birds are simply reflected from the brownish substance which forms the feathers. Newton discovered the theory of these phenomena, and subjected them to measurement; he invented for the purpose the experiment called by the name of Newton's rings. Newton showed, as you know, that when two parallel reflecting surfaces are separated by a very short interval, and illumined by white light, they reflect only one of the colored rays which are the constituents of white light. If, for instance, the interval between the reflecting surface is only $\frac{2}{10000}$ of a millimeter, violet rays are alone reflected, the rest being destroyed by interference; that is, the two surfaces send back two reflected rays whose vibrations interfere with one another, so as to destroy every vibration except that which constitutes violet light. If the interval between the reflecting surfaces be augmented to $\frac{3}{10000}$ of a millimeter, the destruction of vibration takes place for every vibration except that of red light, which alone remains visible in this case.

If we consider now this photograph of the spectrum, and especially the violet end of the image, we find that this is formed by a deposit of brown reduced silver. In the case of an ordinary photograph, this deposit would simply be a formless cloud of metallic particles; here the cloud has a definite, stratified form; it is divided into a number of thin, equidistant strata, parallel to the surface of the plate, and $\frac{2}{10000}$ of a millimeter apart. These act as the reflecting surfaces considered by Newton, and as they are at the proper distances for reflecting violet rays, and these alone, they do reflect violet rays.

The red extremity of the photograph is equally built up of strata which act in a like manner; only their distance intervals here amount to $\frac{3}{10000}$ of a millimeter, and that in the proper interval for reflecting red light. The intermediate parts of the spectral image are built up with intermediate values of the interval, and reflect the intermediate parts of the spectrum.

The appearance of color is therefore due to the regular structure above described, imprinted on the photographic deposit. The next question is—How has this very fine, peculiar, and adequate structure been produced?

It is well known that a ray of light may be considered as a regular train of waves propagated through the ether, in the same way as waves on the surface of water. The distance between two following waves is constant, and termed the wave length; each sort of radiation, each color of the spectrum, being characterized by a particular value of the wave length. Now, when a ray of light falls on a sensitive film, this train of waves simply rushes through the film with a velocity of about 300,000 kilometers per second; it impresses the film more or less strongly, but leaves no record of its wave length, of its particular nature or color, every trace of its passage being swept out of form by reason of its swift displacement. The impression therefore remains both uniform and colorless. Things change, however, as soon as we pour in mercury behind the plates, or otherwise provide for a mirror being in contact with it. The presence of the mirror changes the propagated waves into standing waves. The reflected ray is, namely, thrown back on the incident ray, and interferes with its motion, both rays having equal and opposite velocities of propagation. The result is a set of standing waves—that is, of waves surging up and down each in a fixed plane. Each wave impresses the sensitive film where it stands, thus producing one of these photographic strata above alluded to. The impression is latent, but comes out by photographic development. Of course the distance between two successive strata is the distance between two neighboring waves; this, theory shows, is exactly half the wave length of the impressing light. In the case of violet, for instance, the wave length being $\frac{4}{10000}$ millimeter, half the wave length in the above quoted distance of $\frac{2}{10000}$ millimeter; this, therefore, is at the same time the interval between two standing waves, in the case of violet light, the interval between two successive photographic strata, and at last it is the interval required to exist, according to Newton's theory, for the said strata reflecting violet rays and making these alone apparent, when illumined by white light.

The colors reflected by the film have the same nature and origin as those reflected by soap bubbles or Newton's rings; they owe their intensity to the great number of reflecting strata. Suppose, for instance, the photographic film to have the thickness of a sheet of paper (one-tenth of a millimeter), the fabric built in it by and for a violet ray is five hundred stories high, the total height making up one-tenth of a millimeter. Lord Rayleigh, in 1887, has proved à priori that such a system is specially adapted to reflect the corresponding waves of light.

How are we now to prove that the above theory is really applicable to the color photograph you have seen? How can we demonstrate that those bright colors are due not to pigments, but to the interference, as in the case of soap bubbles? We have several ways of proving it.

First of all, we are not bound to the use of a peculiar chemical substance, such as Becquerel's subchloride of silver; we obtain colors with a variety of chemicals. We can, for instance, dispense entirely with the use of a silver salt; a film of gelatine or coagulated albumen impregnated with bichromate of potash, then washed with pure water after exposure, gives a very brilliant image of the spectrum.

Secondly, the colors on the plate are visible only in the direction of specular reflection. The position of the source by which we illumine the photograph being given, we have to put the eye in a corresponding position, so as to catch the regularly reflected rays. In every other position we see nothing but a colorless negative. Now, as you are aware, the colors of pigments are seen in any direction. By projecting again a photograph of the spectrum, and turning it to and fro, I can show you that the colors are visible only in one direction.

Thirdly, if we change the incidence of the illuminating rays, that is, if we look at the plate first in a normal direction, then more and more slantingly, we find that the colors change with the incidence exactly as they do in the case of soap bubbles, or of Newton's rings; they change according to the same law, and for the same reasons. The red end of the spectrum turns successively to orange, yellow, green, blue, and violet. The whole system of colors, the image of the spectrum, is seen to move down into the part impressed by the

* The glass of the photographic plate has to be turned toward the objective, the film in contact with the metallic mirror.

infra-red. This is what we expect to happen with interference colors, and what again we cannot obtain with pigments.

Fourthly, if while looking at the film normally, we suffer it to absorb moisture—this can be done by breathing repeatedly on its surface—we see that the colors again change, but in an order opposite to that above described. Here the blue end of the spectrum is seen to turn gradually green, yellow, orange, red, and finally infra-red, that is, invisible. The spectrum this time seems to move up into the ultra-violet part of the improved film. By suffering the water to evaporate, the whole image moves back into its proper place. This experiment may be repeated any number of times.

The same phenomenon may be obtained with Newton's apparatus, by slowly lifting the lens out of contact with the plane surface. The explanation is the same in both cases. The gelatine swells up when imbibing moisture. If we consider, for instance, the value of the spectrum, the small intervals between the strata, corresponding to violet rays, gradually swell up to the values proper for green, and for red, and for infra-red; green, then red, then infra-red, are therefore succcessively reflected.

We will wet this photograph of the spectrum with water, project it on the screen, and watch the colors coming back in the order prescribed by theory.

It is necessary to use a transparent film, since an opaque one, such as is commonly in use, would hide the mirror from view; the sensitive substance must be grainless, or, at least, the grains must be much finer than the dimensions of the strata they are intended to form, and therefore wholly invisible. The preparation of transparent layers gave me at first much trouble. I despaired for years to find a proper method for making them. The method, however, is simply thus: If the sensitive substance (the silver bromide, for instance) be formed in presence of a sufficient quantity of organic matter, such as albumen, gelatine, or collodion, it does not appear as a precipitate; it remains invisible; it is formed, but seems to remain dissolved in the organic substratum. If, for instance, we prepare a film of albumeno-iodide in the usual way, only taking care to lessen the proportions of iodide to half per cent. of the albumen, we get a perfectly transparent plate, adapted to color photography.

We want now to go a step further. It is very well for physicists to be contented with working on the spectrum, since that contains the elements of every compound color; but we all desire to be able to photograph other objects than the spectrum—common objects with the most compound colors. We have again but to take theory as a guide, and that tells us that the same process is able to give us either simple or compound colors. We have then to take a transparent and correctly isochromatized film, expose it with its mercury backing, then develop and fix it in the usual way; the plate, after drying, gives a correct colored image of the objects placed before the camera. Only one exposure, only one operation, is necessary for getting an image with every color complete.

A plausible objection was offered at first to the possibility of photographing a mixture of simple colors. The objection was this: a ray of violet gives rise to a set of strata separated by a given interval; red light produces another set of strata with another interval; if both co-exist, the strata formed by the red are sure to block out here and there the intervals left between the strata formed by the violet. Is it not to be feared that one fabric will be blurred out by the other, and the whole effect marred? The confusion would be still worse if we consider the action of white light, which contains an infinity of simple components; every interval here is sure to be blocked up.

Mathematical analysis, however, shows this objection to be unfounded; we have great complexity, but not confusion. Every compound ray, both colored and white, is faithfully rendered. As an experimental proof of this, we will project on the screen photographs of very different objects, namely, stained glass windows, landscapes from nature, a portrait made from life, and vases and flowers.

That the colors here observed are due to interference and not to the presence of pigments can be shown in the same way as with the spectrum. Here, again, we observe that the colors are visible only in the direction of specular reflection, that they change with the angle of incidence, that they change and disappear by wetting, and reappear by drying. Pigments remain equally visible and unaltered in color under every incidence. If we attempted to touch up one of our photographs with oil or water colors, the adulterated place would stand out on a colorless background by merely obscuring by diffused light. It is therefore impossible either to imitate or touch up a color photograph made by the above described interferential method.

DAIMLER MOTOR TRAMCAR.

AMONG the vehicles exhibited in the Imperial Institute Exhibition is a narrow gage tramcar for carrying about a dozen passengers on longitudinal seats, as shown in the accompanying engravings. It has a light canopy over it, and is propelled by a Daimler motor placed in the case shown at one end. At the same end is the seat for a driver, within whose reach are placed the two levers necessary for controlling the movements of the car, the arrangement of the motor, the gearing, and the brake and gear levers. The motor has been already described as to its oil or benzolene and air supply arrangements. It has two cylinders, and is connected to the driving axle by strong gearing thrown in or out of gear by a flat bar connected to the brake lever, M. On this bar is a projection having an inclined surface. This passes through a slotted head projecting from the end of the hollow continuation of the crank shaft at K, the head being connected to the friction clutch by a rod through the hole in the shaft up to the clutch at L. Thus, when the lever, M, is pulled to put the brake on the driving wheels, the driving power is simultaneously cut out by the separation of the friction clutch surfaces, which are pressed together by a spiral spring which is seen between the outer bearing and the small pinion, E. When the latter is in gear, as shown with the wheel, G, on the intermediate shaft, the slowest speed is made, and by pulling the lever, N, out, the pinion, F, is put into gear with the wheel, H, a higher speed being obtained. From the third wheel on this shaft the wheel, I, is driven. At D D are the two cylindrical exhaust boxes. The exhaust from both cylinders passes into the box nearest the engine, and from this it passes by a pipe to the bottom of the second box, from the top of which it passes into the air by a pipe which turns over from the top and leads it to near the ground. The oil vessel is not shown in our sketch, but provision is made for about a day's working. The arrangement of the car and its motor is very neat, and it gives a good idea of what may be done for vehicles

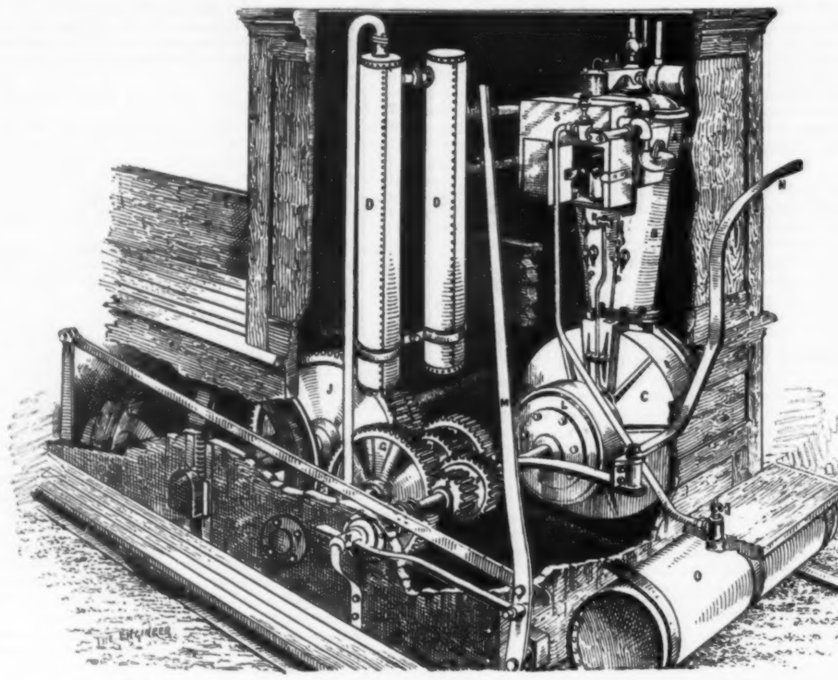


FIG. 2.—MOTOR AND GEARING—SELF-PROPELLED TRAMCAR.

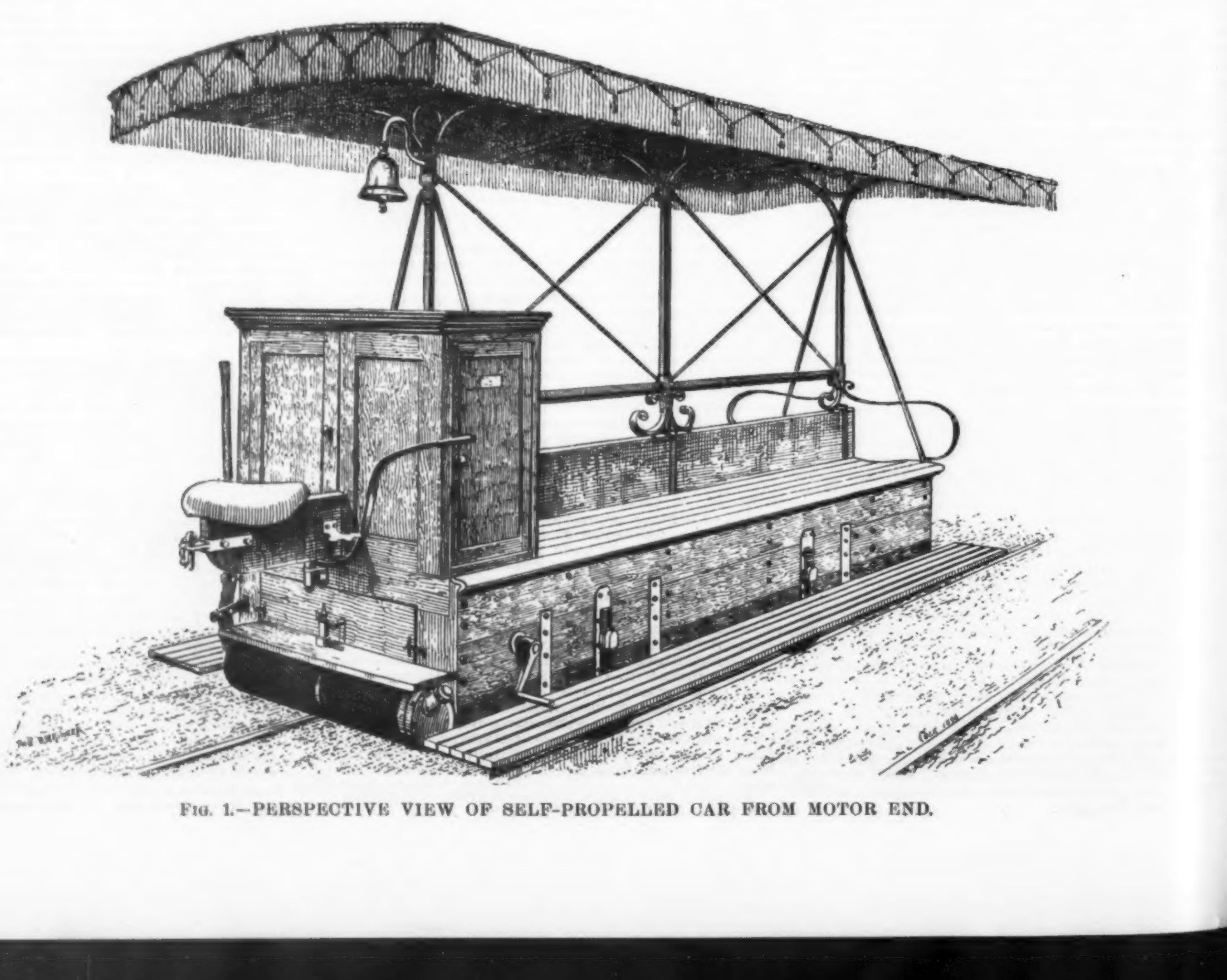


FIG. 1.—PERSPECTIVE VIEW OF SELF-PROPELLED CAR FROM MOTOR END.

for light narrow gage tramways or tramroads. We are indebted to the London Engineer for the cut and copy.

THE MORSE VALVE RESEATING MACHINE.

WE illustrate an ingenious tool intended for refacing valve seats and valves in situ, thus avoiding the loss of time involved in removing the valve box to a lathe or boring machine. As will be seen from our engraving, Fig. 1, the instrument consists essentially of a self-centering chuck which is expanded until it grips tightly the circular opening usual on the flange for the valve cover. A rod passes through the center of this chuck, and bears at its lower end a cutter. This latter is fed down till it comes in contact with the worn seat, and is then turned round half a dozen times, scraping the seat true. The cutters provided are suitable both for flat and beveled faces, and each tool is capable of dealing with a large range of sizes. To reface the valve itself, the latter is fitted into another self-centering chuck, such as is shown in Fig. 3. This latter is then substituted for the cutter on the spindle of the machine. Thus arranged, the tool is transferred to the conical casting shown in Fig. 2, and secured there by means of the self-centering chuck as shown. The spindle is then fed down till the face of the valve comes in contact with the knife shown near the bottom of the cone, when a few turns will render the valve quite true and ready to be reground into place. For deep valve chests a lengthening bar can be fitted to the spindle. Valves of as much as 12 in. in diameter can be trued up satisfactorily in these machines, though the maximum capacity of the one we illustrate is 4 in. All the working parts are made of steel, hardened where necessary. The cutters are ground true to gage, and carefully tempered. Each tool with its accessories is neatly packed in an oak or ash box, so as to reduce the risk of some of the numerous cutters or other parts being mislaid.

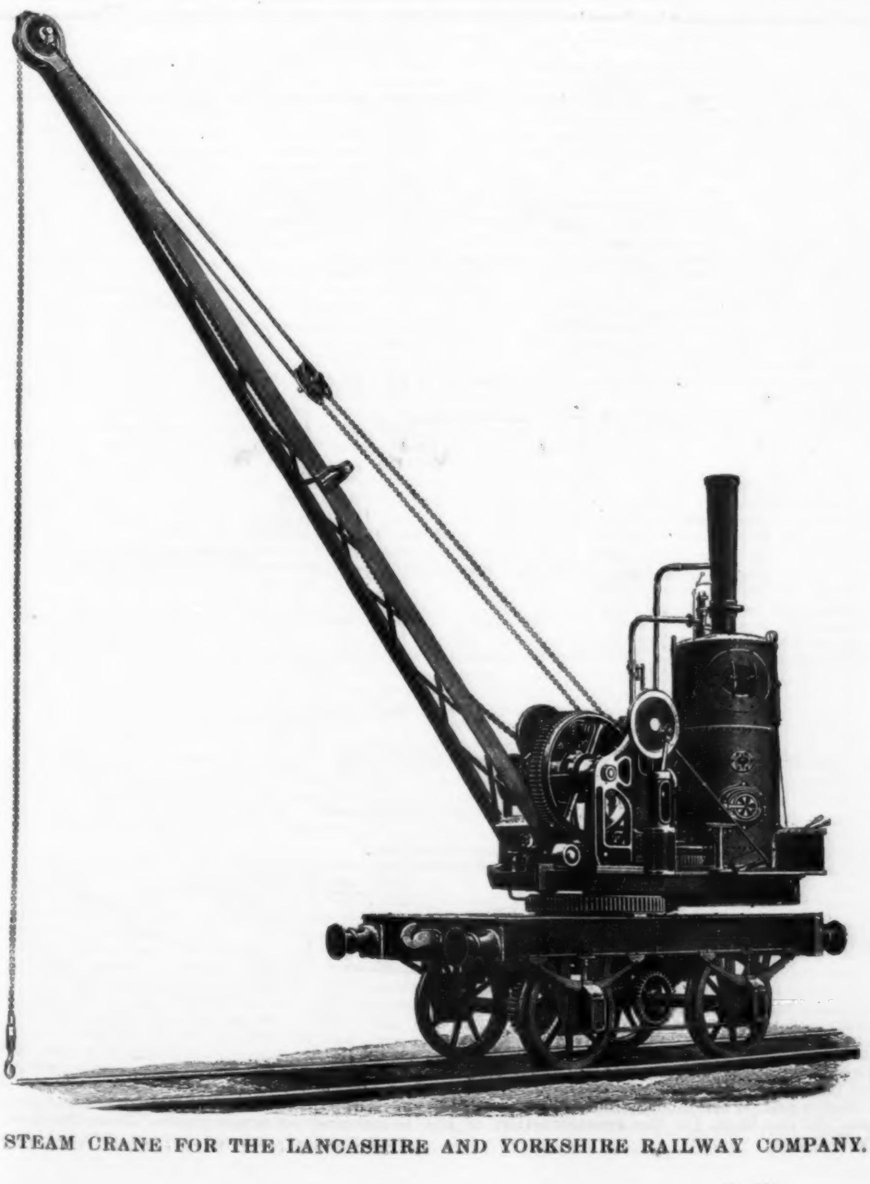
FIG. 1. FIG 3. FIG 2.

THE MORSE VALVE SEATING MACHINE.

SELF-PROPELLED RAILWAY CRANE FOR THE LANCASHIRE AND YORKSHIRE RAILWAY.

WE illustrate herewith a steam traveling crane recently constructed by Messrs. Isles, Limited, of the Steam Crane Works, Stanningley, near Leeds, for the Lancashire and Yorkshire Railway Company, and at present in use at their creosoting works. We are indebted to the London Engineering for the cut and copy. The crane is arranged so that it can be run along with ordinary rolling stock to any part of their system, its self-propelling gear being disengaged and the jib lowered so as to clear the bridges, etc. A special feature of this crane is its high rate of traveling speed, viz., 200 yards per minute. The hoisting motion is of the single purchase type, and a high rate of speed can be maintained. A powerful foot brake is provided for holding the load in any desired position. There are also motions for slewing and jib adjusting, the various levers being so arranged that the whole of the crane is under the control of one man. The different motions can be worked separately or simultaneously as required.

The crane is driven by one pair of engines fitted with link reversing motion, and the boiler is of the vertical type, made entirely of steel plates, and designed for a working pressure of 80 pounds. A water tank is placed beneath the boiler, containing about half a day's supply. The carriage frame is built up of rolled steel channels, plates, and angles, and the central pillar is forged from Siemens-Martin mild steel. The tram wheels are steel tired, and arranged to run on the 4 ft. 8½ in. gage. The axles, axle boxes, and springs have all been made to the railway company's standard sizes. Before delivery the crane was tested with a load of 2 tons at 16 ft. radius.



STEAM CRANE FOR THE LANCASHIRE AND YORKSHIRE RAILWAY COMPANY.

DEVELOPMENT IN DESIGN AND CONSTRUCTION OF GERMAN MEN OF WAR.*

By Herr A. DIETRICH, Wirklicher Geheimer Admiralitatsrath, Constructor in Chief of the Imperial German Navy, in the Engineer.

THIRTY years ago only one shipyard in Germany was able to construct men of war adequate to the demands of the time, the Royal Prussian Dockyard, at Danzig. At the time this yard was building the wooden screw frigate Elizabeth, and a short time later two ships for the newly formed North German Confederation, the Undine, a sailing brig for training purposes, and the armored screw corvette Hanse, of 3,600 tons displacement; the last one was the first ironclad vessel ever built in Germany. The dockyard at Danzig was fitted out to build only wooden hulls, so the iron unarmored superstructures of this ship were built up by the Vulcan private dockyard at Stettin. The armor plates were ordered from England. In the year 1869 the first iron armorclad ever built in Germany, the turret ship Grosser Kurfurst, was commenced in Wilhelmshaven, where the new dockyard was not even nearly finished. The shipyard Vulcan, in Stettin, started shortly afterward on the Preussen, a sister vessel of the Grosser Kurfurst. Work on these vessels could only be carried on very slowly during the time of the Franco-German war, so that the first iron armorclad built in Germany, the Preussen, could not be launched before November, 1873. Her sister ship, the Friedrich der Grosse, was launched in 1874 from the new imperial dockyard at Kiel. Owing to the unfinished state of the dockyard at Wilhelmshaven, and the very unfavorable conditions, the Grosser Kurfurst was not ready for launch before September, 1875, six years after work was commenced.

After the Franco-German war the chief of the German Admiralty, Gen. Von Stosch, laid out a plan to build up the navy—Flottergrundungsplan—according to which work was commenced, but is not quite finished at present, as not all types of ships have the intended number of vessels. To get armorclads as quickly as possible, it was necessary to place orders abroad, since German shipyards were not efficient enough at that time. The two armored frigates, Kaiser and Deutschland, were built at Samuda's dockyard from the designs of Sir Edward Reed, and were launched in the year 1874. These two ships form still part of the German battle fleet, after having been reconstructed, as well as it was possible, to suit modern requirements. Since that time no German man of war of any considerable size has been built abroad. The German shipyards were in the meantime well fitted to execute all orders. Then those vessels were commenced which suited best the formation of the German coast. According to the building plan, four coast defense armorclads—Ausfall Corvettan—of the Sachsen type were ordered, which, on a draught not exceeding 6 m. (19·68 ft.) had to carry the heaviest armor of 16

* Read at the summer meeting of the thirty-seventh session of the Institution of Naval Architects, June 9.

in. thickness—Sandwich system—and an armament of six guns of 26 cm. (10 in.) caliber. These ships are nearly the first armorclads ever constructed on the citadel type. The keel of the Sachsen was laid as early as 1874, and she was launched in 1877; the first citadel ships, the Inflexible and the Duilio, were launched in 1876. The last of the three sister ships of the Sachsen type, the Baden, was not launched till 1880.

Coast defense had to be considered before everything else, and, therefore, contemporaneously with the above mentioned vessels, work was commenced, not on monitors, as at first planned, but on ironclad gunboats of the Wespe type. These boats, of 1,000 tons displacement, were plated 8 in. (200 mm.) armor, carried one gun of 12 in. (30·5 cm.) caliber, and drew only 3 m. (9·84 ft.) Eleven of these boats were built. For a long time no armorclad was built in Germany except the Oldenburg, which was started in March, 1883, and finished in November, 1886. She was intended to be the fifth vessel of the Sachsen type; but, owing to want of money, she had to be made smaller and of quite another type. With the armorclad Siegfried a quite new type was started in 1887, also intended for coast defense only, and especially for the mouth of the River Elbe, on account of the construction of the Kaiser Wilhelm Canal. Eight vessels of this type were built, but the last two, the Aegir and Odin, are somewhat different from the sister ships, being constructed after the citadel type ships. The main condition for these vessels is also the low draught, only 5·5 m. (18 ft.) They carry, on a displacement of 3,500 tons, heavy ordnance, three 24 cm. guns, arranged especially for defending river estuaries, and are armored with 240 mm. ($9\frac{7}{16}$ in.) plates, and have a speed of 15 knots. Thus, since 1873, three different types of armorclads, of 7,400 tons, 3,500 tons, and 1,000 tons, were built for coast defense, each type designed and executed for this limited purpose.

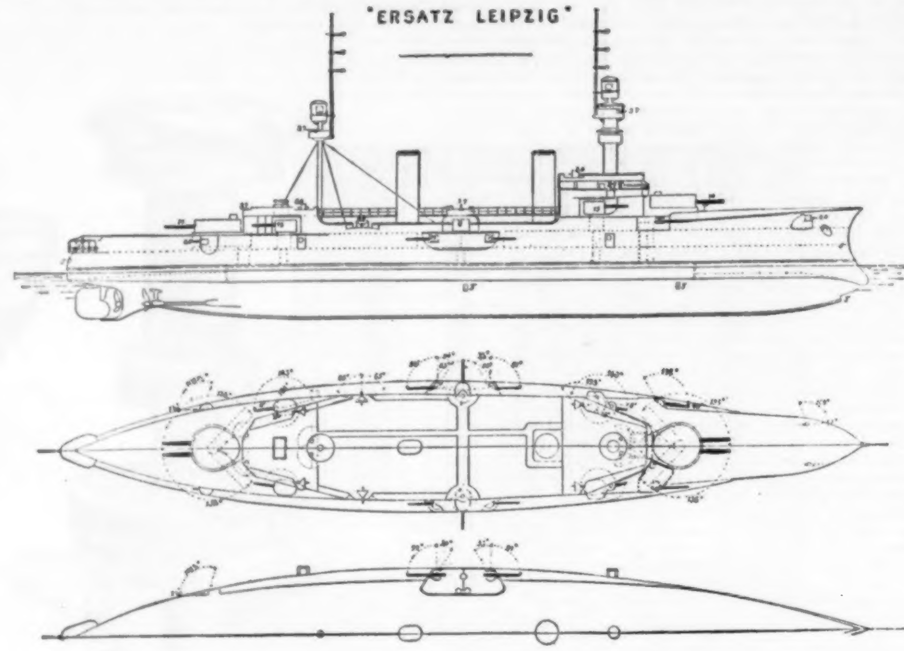
The construction of seagoing armorclad battleships, which have to advance farther out, in order to defend the coasts more effectually, was not commenced before 1889, after a lapse of sixteen years. Then, however, four vessels of the same design were started simultaneously; these are the Brandenburg, Weissenburg, Wörth, and Kurfurst Friedrich Wilhelm, of more than 10,000 tons displacement, a speed of 17 knots, 400 mm. (15·75 in.) thickness of armor in the belt which surrounds the water line, and, in addition to a reduced light armament, six guns of 28 cm. (11 in.) caliber in three revolving turrets. Two still bigger ships, the Ersatz Preussen and Ersatz-Friedrich der Grosse—to replace the before mentioned ships—whose principal dimensions were materially affected and restricted by the small size of the existing German dry docks, are being built now at the Imperial Dockyard at Wilhelmshaven. The development of the unarmored ships was strongly influenced by closely adhering to and imitating the types of screw frigates and corvettes existing in the year 1871 in the German navy, the type of the full rigged single screw frigates and corvettes with broadside guns without any armor protection. The vessels had full sailing capacity, and great stress was laid on the training of the crew in the rigging, but the fighting capacity of the vessels was neglected. Such vessels were constructed even as late as 1887—Charlotte, Arcona, Alexandrine.

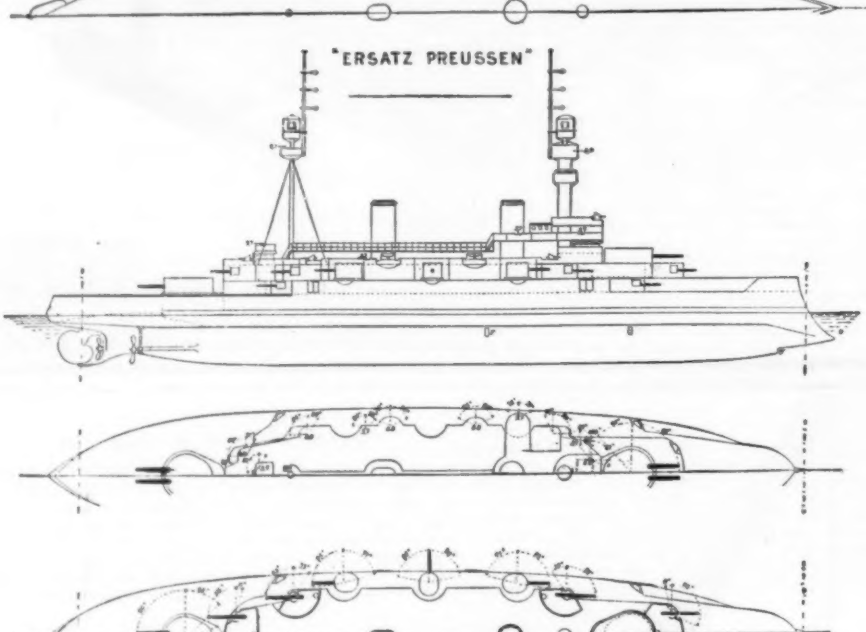
Cruisers to suit modern requirements were not commenced before 1885. Three of those vessels of the second class have been built up to now, the Irene, Princess Wilhelm, and the Kaiserin Augusta; the last of which is the first triple screw ship which crossed the Atlantic. Up to 1895 only one moderately armed and protected cruiser of the third class—Gefion—was built, together with a number of smaller cruisers of the fourth class, Bussard type. By this time the want of cruisers was felt so severely that three second class cruisers of more than 5,600 tons—Ersatz Freya, K and L—and one first class armored cruiser of 10,650 tons—Ersatz Leipzig—were commenced. To these vessels were added this year two more cruisers of the second class—M and N.

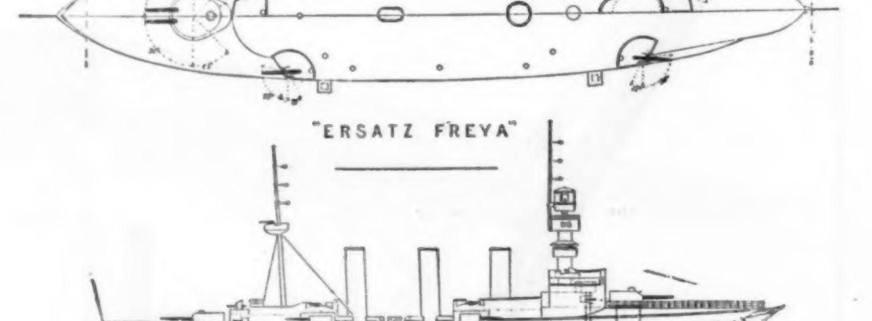
A special feature in the German navy has always been the "avisos," speedy vessels of small fighting capacity, designed only to serve as scouts for the fleet. But soon these vessels were required to fight, especially after the introduction of the torpedo; in consequence, the vital parts had to be protected. Out of the last German vessel of any size built abroad, by the Thames Iron Works, 1875-76, viz., the Zieten, the modern German "avisos" were developed. These were first of all the Blitz and Pfeil, with under-water torpedo armament and of 16 knots speed, forerunners of the later built English boats, Surprise and Alacrity. The Greif, of 19 knots speed, succeeded in 1885, and was followed by the Wacht and Jagd, of $19\frac{1}{2}$ knots speed, and fitted with a protective deck. After these come two small "avisos" of the same speed, the Meteor and Comet, of 1,000 tons, and then the "aviso" Hohenzollern, a splendid vessel fitted out as an imperial yacht, with 21·5 knots speed, of about 4,000 tons displacement. The last of the "avisos" is the Hela, of 2,000 tons displacement, now beginning her trials. I will pass over the torpedo division boats and torpedo boats, even though the development of these craft in Germany is very interesting.

This short review, perhaps, shows some of the difficulties which had to be dealt with to build up the navy. But now the strong influence of his Majesty the Emperor, supported by the great efficiency of the German shipyards and steel works, and all those other trades which help to finish a modern man of war, opened up the way for the new development. In the years after 1870, as the material was needed for naval vessels to be built in Germany, iron works had first to prepare to fulfill the orders for material of the same quality as was required by the English rules, which were adhered to. Plates and angles were soon produced, just of the same good quality as in England; but it was difficult to forge heavy pieces, like stems, sternposts, and rudder frames for bigger ships, and for several years these had to be ordered from England. To-day in this respect, too, German works are equal to any demand; the stem and sternpost, with rudder frame of one of the armorclads of the Brandenburg type, made by Krupp, was much admired at the Exhibition in Chicago. The production of armor plates for our armorclad ships and vessels shows a rather slow development. The armor plates were first ordered in England, from Charles Cammell & Company and John Brown & Company, both in Sheffield. In 1876 the Dillinger Works, on the Saar, made preparations to produce iron armor, and furnished first the 203 mm. (8 in.) plates for a number of armored gunboats of the Wespe class, afterward plates of 254 mm and 305 mm. (10 in. and 12 in.) thick for two ships of the Sachsen type—the Baden and Wurtemberg; and in 1879-80 plates 305 mm. (12 in.) thick for the reconstruction of the König Wilhelm.

In 1880 the Dillinger Works obtained the English "Wilson" patent for producing steel faced armor plates—compound armor—and furnished those plates first for the Oldenburg and thereafter for all armor plated German ships, until in 1890 steel faced plates were superseded by nickel armor plates, which are also produced by the Dillinger Works. Since 1891 the works of Krupp, in Essen, also have made great preparations to manufacture armor plates. These two factories now work together, and not only can turn out all the armor







plates needed in Germany, but execute foreign orders also. The latest face hardened armor plates of these two works are, perhaps, the best plates produced anywhere. Germany has become perfectly independent in this respect also.

England has been Germany's teacher in the construction of hulls, engines and boilers. Those ships which were bought from and built in England for the German navy had to serve as standards from which to imitate the details. Our inspectors kept their eyes and ears open, and the many publications, as, for instance, Sir Edward Reed's and Sir William White's precious works, the "Transactions" of the Institution of Naval Architects, the instructive articles in the periodicals—the Engineer and Engineering—offered an abundance of information to those who intended to learn, like the Germans of that time.

The engines of the screw frigate Elizabeth had to be ordered in 1867 from England—Maudslay—because they could not be designed and built in Germany. The first larger screw engines for navy ships were constructed in 1871, and in the following year at the works of Egells, in Berlin, for the corvettes Ariadne and Luise, and at the Vulcan Works in Stettin, 1874, for the armorclad Hansa. These engines were of English model in general design and entirely so in all details. But since that time German industry has made such progress in the building of large marine engines that it now comes up to the highest standard and has grown to be wholly independent. Already, nearly twenty years ago, German manufacturers went their own way in working out the plans and the details of engines and boilers, taking advantage of all the new inventions in England and France. To day the construction of navy vessels in Germany is worked out from original ideas in order to fulfill the military requirements for each type. The new German men of war now in course of construction will, in many respects, be worthy of interest, since all modern improvements in science and technical knowledge have been taken advantage of to produce a most perfect tool for any war purpose.

I shall describe now in a few words some arrangements in which German men of war, in my opinion, differ from the English built warships. I mention here, first of all, the divisions into watertight compartments. The armorclads, armored cruisers and protected cruisers are divided into as many watertight compartments as it was deemed possible without interfering with the working of the vessel. Perhaps this is carried out already too far, and the service on board may be obstructed. The paper of Lord Charles Beresford, read before the meeting of the Institution in March of this year, mentions those considerations which prompted the constructor here to carry every athwartship bulkhead above the waterline without any door in it. Any door may be left open. Therefore, one has to accept the probability that it will be left open, and, consequently, it is better to have no door at all. Communication from one engine room to the other, from one stokehold to the other, must be established over the protective deck above water or may be carried on below by telegraphs and speaking tubes. Only in the athwartship bulkheads, which are beneath the protective under-water deck of citadel ships, or in the foremost and aftermost parts of protected cruisers, doors are permitted. This circumstance speaks strongly against the construction of such vessels. The above mentioned principle is strictly adhered to in all new German navy vessels. It is difficult to ventilate a ship divided in this way. Air from above must directly lead into and out of each compartment between two athwartship bulkheads, which has direct access from above. Only for the forward and aft compartments underneath the protective under-water decks air ducts are carried through the athwartship bulkheads, and watertight shutters have to be provided for, which are perhaps insufficient, but have to be made use of in vessels of the citadel type.

Modern vessels suffer a great deal from the heat which radiates from the steam piping belonging to the large number of auxiliary engines installed in all parts of the ship and which supplies the ship with continuous steam heating. All attempts of engineers to cover these pipes with non-conducting materials and to insulate them so as to prevent this radiating heat have entirely failed, and every room through which a steam pipe is carried is heated very disagreeably. The best method of counteracting these effects of steam engines and steam pipes was found to be by omitting them and by employing electricity, the conducting wire taking the place of the steam pipe. Only by driving the many fans made necessary for the watertight compartments by electricity is the division into so many compartments rendered at all possible. All new German warships in course of construction have electricity as motive power, not only for those ventilating fans, but also for the turning gear of the 15 mc. gun turrets, for ammunition hoists, for boat hoisting and coaling winches and such like gear. For the turning gear and ammunition lifts of the heavy guns hydraulic power has been retained and steam is still used for the steering gear where it was especially difficult to install the electric motor, as well as for the anchor windlasses, which are only comparatively seldom used. Only one vessel in the German navy, the nearly finished Aegir, is experimentally fitted throughout with electric appliances, even for steering gear and windlasses. The results of these experimental installations will decide if, in the future, electricity can be used more extensively for motive power on board ships, and if the heat sources can be further dispensed with.

His Majesty's cruiser Kaiserin Augusta of 6,300 tons displacement, over 13 000 indicated horse power and with a speed at load draught of over 21½ knots, is the first German vessel with three screw propellers; she is also the first triple screw steamer which ever crossed the Atlantic. [In 1893, in order to be present at the celebration of the four hundred years' jubilee of the discovery of America.] It is hardly necessary to discuss at any length the considerations which caused the adoption of a system accepted already some time before in Italy for the Tripoli, and decided on in France for the Dupuy de Lôme. By dividing the excessive motive power of the modern warships into three parts, the smaller engines could be more easily constructed, and, as they do not stand so high, it is less difficult to place the vertical engines underneath the protective deck.

Details as to German Warships in Course of Construction, 1896.

Class of ship.	1st Class battleship.	1st Class cruiser.	2nd Class cruiser.	2nd Cl. cruiser.	2nd Cl. cruiser
Name.	Ersatz-Preussen.	Ersatz-Leipzig.	Ersatz-Freya.	K.	L.
By whom designed	A. Dietrich, Constructor-in-Chief	As before	As before	As before	As before
When and where laid down	Imp. Dockyard, Wilhelmshaven, March, 1895	Imp. Dockyard, Kiel, Autumn, 1895	Imp. Dockyard, Danzig, October, 1895	Vulcan Works, Stettin	Weser Works, Bremen
Date of completion (presumed)	1898	1898—99	1897	1897	1897
Material of hull	Steel	Steel, wood sheathed, Muntz metal bottom	Steel		
Length between perpendiculars	115·0 m.	120·0 m.	105·0 m.		
Breadth extreme	20·4 m.	20·4 m.	17·4 m.		
Mean load draught	7·85 m	7·9 m.	6·25 m.		
Displacement in tons of 1000 kg.	11,130	10,650	5650		
Armament:— (1) Ordnance	Four 24 cm. in two armoured revolving turrets Twelve 15 cm. Q.F. in armoured single casemates Six 15 cm. Q.F. in armoured revolving turrets Twelve 8·8 cm. Q.F. with shields Twelve 3·7 cm. Q.F. machine guns Eight 8 mm. Q.F. machine guns	Four 24 cm. in two armoured revolving turrets Six 15 cm. Q.F. in armoured single casemates Six 15 cm. Q.F. in armoured revolving turrets Ten 8·8 cm. Q.F. with shields Ten 3·7 cm. Q.F. machine guns Eight 8 mm. Q.F. machine guns	Two 21 cm. in two armoured revolving turrets Four 15 cm. Q.F. in armoured single casemates Four 15 cm. Q.F. in armoured revolving turrets Ten 8·8 cm. Q.F. with shields Ten 3·7 cm. Q.F. machine guns Four 8 mm. Q.F. machine guns	As before	As before
(2) Torpedoes	One 45 cm. † stem tube Four 45 cm. ↓ broadside tubes One 45 cm. † stern tube	One 45 cm. ↓ stem tube Four 45 cm. ↓ broadside tubes One 45 cm. † stern tube	One 45 cm. ↓ stem tube Two 45 cm. ↓ broadside tubes		
Armour:— Belt	On ⅔ length from forward thickness 300, 250, 200, and 150 mm. hardened steel	All round the water-line, thickness 200 and 100 mm. hardened steel	—		
Turrets	24 cm. 250 mm. thick 15 cm. 150 mm. thick	24 cm. 200 mm. thick 15 cm. 100 mm. thick	21 cm. 100 mm. thick 15 cm. 100 mm. thick		
Casemates	15 cm. 150 mm. thick	15 cm. 100 mm. thick	15 cm. 100 mm. thick	As before	As before
Conning towers	290 and 150 mm.	200 and 100 mm.	200 and 100 mm.		
Armoured decks	On top of belt, 65 mm., underwater armoured deck aft 75 mm.; splinter decks, 20 mm.	On the citadel on top of belt, 50 mm.; before and abaft, 30 mm.; underwater armoured deck before and abaft, 50 mm.; splinter decks, 20 mm.	Horizontal above-water part of protective deck, 40 mm.; inclined sides, 100 mm.		
Makers of machinery	Imp. Dockyard, Wilhelmshaven	Imp. Dockyard, Kiel	Germania Works, Tegel, Berlin	Vulcan Works, Stettin	Weser Works, Bremen
Number of screws	3	3	3	3	3
Indicated horse-power	13,000	13,500	9000	9000	9000
Engines	Vertical 3-cyl. triple-expansion	Vertical 4-cyl. triple-expansion	Vertical 3-cyl. triple-expansion	Vertical 4-cyl. triple-expansion	Vertical 4-cyl. triple-expan.
Boilers	For ⅔-power cyl. Scotch boilers For ⅓-power water-tube boilers	For ⅔-power cyl. Scotch boilers For ⅓-power water-tube boilers	Niclausse boilers	Belleville boilers	Dürr boilers
Speed at load draught	18 knots	18·5—19 knots	18·5 knots	18·5 knots	18·5 knots
Coal capacity at load draught	650 tons (of 1000 kg.)	1000 tons (of 1000 kg.)	500 tons (of 1000 kg.)	500 tons (of 1000 kg.)	500 tons (of 1000 kg.)
Masts	Two military masts with fighting tops, foremast with inside ladderways	As before	As before	As before	As before
Number of crew	655	565	439	439	439

In a combat additional security of working is provided, as compared with the twin screw ships, and, lastly, saving of fuel should result in using only one of the smaller engines when cruising at reduced speed. Although the engine room staff has to be augmented, greater engine space is required, and the three engines themselves are to a small extent heavier, these disadvantages were not considered important enough to outweigh the advantages of the triple screw for all battleships and for the first and second class cruisers in the German navy. Triple screws are provided for the new battleships Ersatz-Preussen and Ersatz-Friedrich der Grosse, the armored cruiser Ersatz-Leipzig and the second class cruisers Ersatz-Freya, K, L, M and N.

In all the new ships the armament and its protection, in accordance with the latest experience, requires so much of the weight which makes up the displacement that somewhere else weight had to be saved, which would be available for armor and guns. Nowhere could weight be reduced, since more was asked for everywhere. Though, to facilitate work, more auxiliary machinery is installed, the number of the crew is not diminished; these engines require even more attendants. The weight of hull is, through rational construction and reduction of the scantlings, lessened as much as the strains will permit, in some cases even in excess of a sufficient margin of safety. Considerable reduction in the weight of the ships' hulls was effected by the restricted use of wood. The splinters of wood scattered by penetrating shells were always dreaded, the experiences drawn from the battle at Yalu have clearly shown how dangerous such combustible material as wood is for the construction of a ship and its fittings.

In the outfit and thè construction of the new German ships wood is used only for a few minor parts. Wooden deck planks are no longer laid. Steel deck plating is covered with linoleum, sometimes over a layer of cork. In the crews' quarters the sides of the ships are not ceiled; in the officers' rooms the ceiling is made of steel plates 1½ mm. thick and lined with cork. For cabin bulkheads the steel is covered with thin woolen cloth and with cork lining underneath where it is desirable to exclude sound or lower the temperature. Where heat is radiated from engine or funnel casings cork lining is resorted to. All wood is removed from the ammunition rooms save the racks for shells and powder charges, which are still made of wood. For all ladders and steps steel is used. The hand rails on the conning bridges are no longer of wood, but of some other material which will not burn or splinter, and which is more agreeable to the touch of the hand than steel or brass. Chart houses and captains' rooms on bridges are entirely made of steel and fitted out with non-combustible materials. Since all such changes will be a little exaggerated, it seemed to be advisable to abandon wood for the interior fittings, and especially for the furniture, and to resort to fireproof material, which will not splinter. Many things were tried. Furniture was made of steel and aluminum, lined with cork and covered with linoleum or canvas, but it was not equal to wood furniture. Only the bedsteads are constructed of iron, steel or brass, which materials are also much in use ashore. The insignificant quantity of wood in the few pieces of furniture when ignited is not the dangerous source of smoke, but much more is the outfit of the staterooms, the mattresses, blankets, clothing, books, etc. Therefore, for the present, wood cannot be abandoned entirely. Top and signal masts, flag poles, etc., will be made of steel, but there one cannot save weight.

The fighting capacity of the ships is, without doubt, increased through these innovations, since the ship is less apt to burn, the effects of splinters are restricted and considerable weight is saved, which is available for ordnance and armor. But still greater reductions were needed, and though the power of the engines had to be raised, their weight had to be kept as low as possible. In the engine department the condenser plant is now exceedingly complicated; also, the boilers are at present very heavy in consequence of the high pressure used; boiler feed water, which was formerly not needed, has to be carried, and the weight of machinery has increased above that of the old engines with low pressure when the boilers were fed with sea water. Granted the modern engines consume less coal, is it not better to save weight with a less complicated engine and carry more coal? I only refer here to engines of war vessels, where quite other conditions prevail than in the mercantile marine, where the vessels always go at full power, while the man of war very seldom utilizes the full power of her engines and boilers. This is a chapter by itself worth the investigation of a specialist, who could thoroughly clear up this question, but it is outside the scope of this paper.

The engine weights could not be reduced, so one had to look for reduction to the boilers, which represent such a considerable weight. Here a reduction could be had by adopting the water tube boiler. This problem of the water tube boilers is one of the most important and difficult ones in modern marine engineering, and is very actively discussed in the English, French and German navies. Subsequently to the French and English navies, the German has also taken decided steps, accepting water tube boilers for many vessels. Not less than four different kinds of water tube boilers are adopted for the new German ships now in course of construction, viz., Aegir, armorclad, fourth class, 4,800 indicated horse power, Thornycroft boilers; Ersatz-Freya, cruiser, second class, 9,000 indicated horse power, Niclausse boilers; K, cruiser, second class, 9,000 indicated horse power, Belleville boilers; L, cruiser, second class, 9,000 indicated horse power, Durr boilers. The two armorclads of the first class, as well as the armored cruiser Ersatz-Leipzig, will be fitted with two cylindrical boilers and one-third water tube boilers of the system which will be found best from the results of the trial trips soon to be commenced.

The English navy seems to prefer Belleville boilers for bigger ships; the French navy provides for these ships, together with the Belleville boiler, those of D'Allest and of Niclausse; the Dürr boilers are very similar to those last mentioned. The trial trips of this and the next two years will show more clearly the value of the different types of the boilers. All the so-called theoretical discussions and contentions are useless. Only practical experience can decide this question, but years may lapse before it is settled. In the future the use of water tube boilers cannot be avoided in navies. By fitting them for one-third of the engine power—13,000 indicated horse power—in first class ironclads about 140 tons of weight are saved; and the reduction of weight for second class cruisers of 9,000 indicated horse power, where water tube boilers are entirely used, amounts to about 280 tons. The combined working of water tube and cylindrical boilers was the subject of a paper at the meetings of the Institution last year, but no decided opinion was arrived at. In the Dutch navy, too, the combined system is adopted for the three new large cruisers, but in a different form to ours, as the Dutch intend to generate two-thirds of the engine power with water tube boilers and one-third with cylindrical boilers. The leading idea in the German arrangement is that, as a rule, the vessel steams at reduced speed and uses only one set of cylindrical boilers, keeping the other free for easy cleaning. The water tube boilers are provided in order to get up in the shortest time steam for the highest engine power; at all other times fires are drawn from those boilers.

The greater coal consumption seems to be a drawback to the use of water tube boilers; only actual

trials of ships in service will decide the merits of each type of boiler. In the meantime we are in the dark. It is at any rate hazardous to proceed with the use of water tube boilers so long as we have only the experience acquired in the French navy, and nowhere else; but the increased fighting power demanded, which cannot be provided otherwise, forces us to such action. What an engineer of note wrote a short time ago in the Daily News is certainly correct, viz., "In the next war the side which has the best boilers will win."

Some more characteristic features of German ships of war could be brought forward. For instance, the fact that the protective underwater deck is never cut through for ventilation or coaling purposes; then the peculiar construction of the cork-filled cofferdams; the singular shape of the stern and rudder; the very high bow and low stern; but it would take too much time to thoroughly deal with them. The annexed table and three sheets of sketches contain the particulars of the German men of war of the latest type. I trust, though this paper is necessarily very incomplete on account of the very short time available for its preparation, the Institution will perceive from it how hard we had to work here in Germany to call into existence a navy in the short space of a quarter of a century; how we had to study and to test in order to achieve the result that the vessels planned by German designers and constructed out of German material in German dockyards shall be fully equal to the vessels of the old English and French navies. I hope that this may be the case.

ACETYLENE AS AN ILLUMINANT.

ACETYLENE gas lighting has made considerable progress; in fact, acetylene has entered upon the era of practical applications. It is no longer the gas burning with a fuliginous flame that was not very long ago described in treatises upon chemistry, but is now a gas destined to make a brilliant place for itself alongside of the best light-producing carbides of hydrogen.

Acetylene is manufactured by simply causing water to act upon carbide of calcium. One kilogramme of the carbide placed in the presence of 642 grammes of water produces, with a strong disengagement of heat, 114 grammes of lime combined with water and 500 grammes of acetylene occupying a volume of 342 liters at the pressure of the atmosphere.

Carbide of calcium is a black substance which is obtained by fusing a mixture of carbon and lime in an electric furnace. There forms carbide of calcium and oxide of carbon, which ignites in the furnace.

In order to obtain one ton of carbide it requires 700 kilogrammes of carbon and 1,000 of lime. This necessitates 2,666 electric horse power acting for an hour. This is a great amount of energy, that can be furnished only by electric plants that have at their disposal a cheap motive power, such as that furnished by waterfalls. At Buffalo, in the United States, an establishment is about to be installed that will borrow several thousand horse power from Niagara Falls, but things can be done upon a smaller scale. According to a recent paper by Mr. Charles Jacquin, there is utilized at Froges for such manufacture the small brook of Adrets, the very feeble discharge of which varies between three cubic meters and one-fourth of a cubic meter a minute, and which at this place falls from a height of 200 meters. The water of this brook, led into an iron plate conduit 500 meters in length, furnishes from 500 to 1,000 horse power. This power serves to actuate three turbines, upon the shaft of each of which is mounted a dynamo that furnishes the electric energy. Each dynamo is capable of supplying three furnaces.

Our first figure represents one of these furnaces, which are parallelopipedons of graphite 1·8 meter in height by 1·5 in width and depth, covered externally with a cast iron jacket and provided with a cavity that communicates with the orifice, O, through which the mixture of carbon and lime is introduced. These blocks are provided at their lower part with an orifice, opposite which there is a receptacle designed to receive the fused material. The negative conductor, N, of the current is fixed to the posterior wall of the furnace. The positive one, P, reaches the upper part of a carbon electrode that may be raised or lowered to any extent desired by means of a hand wheel that gears through a pinion with the rod of the electrode. The workman in charge of the furnace, standing behind a mica screen designed to protect him against the radiation, observes the white flame that escapes from the charging orifice, O, while at the same time he keeps his eyes fixed upon a voltameter and an amperemeter. He consequently regulates the insertion of the carbon electrode. As soon as the reaction is finished (say at the end of about forty minutes), he opens the outlet aperture and charges the furnace anew through the orifice, O. Each furnace is capable of yielding about 300 kilogrammes of carbide at the end of twenty-four hours.

The net cost of carbide is at present 0·45 franc per kilogramme. It was not very long ago that this material was priceless. This very low cost has been very rapidly reached, owing to the fact that the manufacture of the new product has been done in establishments equipped for the electrolysis of aluminum, and that it has not been necessary to erect large works, as is usually done for the manufacture of new products. But it may be deduced from this very fact that the cost will be reduced but slightly and very slowly.

Portable acetylene lamps have been put upon the market from the very inception of the movement. These are the simplest generators that could be imagined. Theoretically, the production of the gas in these lamps should be regulated automatically by its consumption, but, in reality, the gas is produced even when the carbide deposited in the small basket is no longer immersed in the water. Hence excessive pressures that cause an irregularity of the flame. In order to have a good portable acetylene lamp, it would be necessary to provide it with a regulator. Now, we have here costly and delicate complications, owing to which kerosene and the stearine candle will still hold sway.

For filling acetylene generators, Mr. Bullier employs a very simple apparatus which requires but little surveillance. The generator always contains water and a basket of carbide, which is immersed more or less deeply in the liquid. A manometer permits of controlling the pressure at every instant. The gas before entering the gasometer is forced from its water in a refrigeratory and drying apparatus. This gasometer, in which the gas is stored, may be a simple iron plate receptacle (Fig. 3) provided at one extremity with a cock for the filling and at the other a special cock that permits of directly supplying one or more burners without an expander or regulator to increase the cost of the installation.

The acetylene burners should have a very narrow slit or be provided with very small apertures. We find some in the market that burn 20 liters an hour. As the price of gas is now 1·5 franc per cubic meter, the expense is very small, taking into account the fact that an acetylene burner possesses about fifteen times greater illuminating power than a Bengal burner and three times greater than one of the Auer type. In a number of cases, that is to say, wherever there are no gas works and where it is a question of having installations of medium importance, acetylene is economical, and it is indicated for the lighting of railway and tramway cars. On the contrary, wherever there are extensive distributions of gas, gas with incandescent mantles is about 60 per cent. cheaper. Private installations of electric lighting with gas or gasoline motors are, therefore, alone destined to suffer from this unexpected competition.

Acetylene offers no greater danger of explosion or toxicity than ordinary gas. It is even claimed that it is a wonderful antiseptic, but this is doubtless one of those exaggerated statements that we are used to hearing in regard to all new things that acquire success.—Le Monde Illustré.

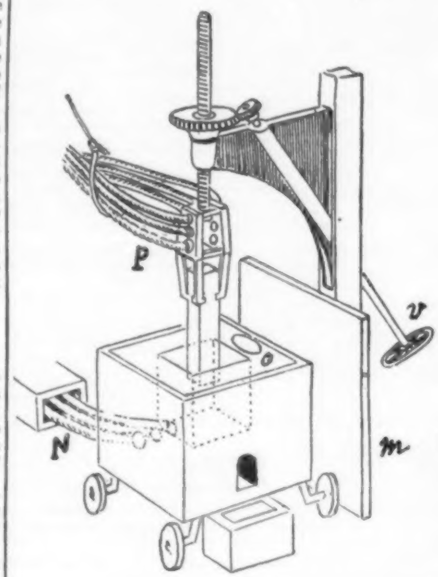


FIG. 1.—ELECTRIC FURNACE FOR THE MANUFACTURE OF CALCIUM CARBIDE.

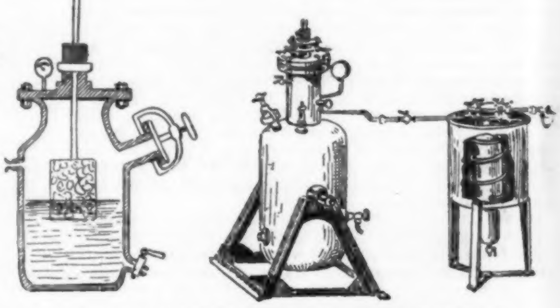


FIG. 2.—APPARATUS FOR GENERATING ACETYLENE.

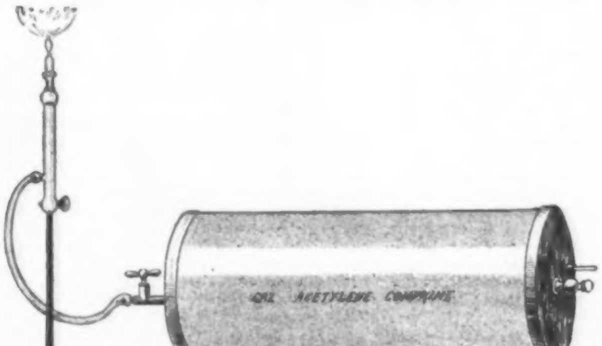


FIG. 3.—ACETYLENE RESERVOIR.

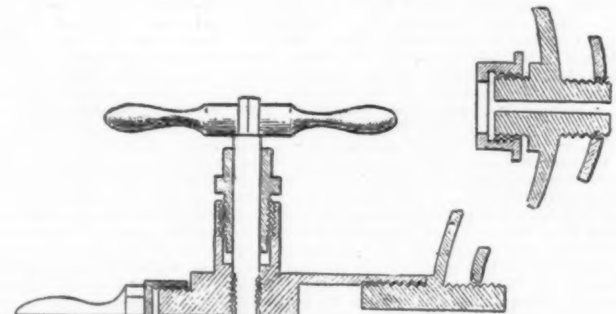


FIG. 4.—COCK FOR THE ACETYLENE RESERVOIR.

THE STAMPING OF SILK.

IN stamping silk a size which will permit the gold to be laid on has long been in demand. It must not stain the most delicate material, nor add to its stiffness, and at the same time it must make the process of stamping more economical and certain.

For a size of this kind the ingredients used, according to a writer in the Dyer and Calico Printer, are equal proportions of gum tragacanth and albumen, the albumen to be about the consistency of skimmed milk and the gum dissolved in water to the thickness of cream. Equal proportions of these must be thoroughly mixed in a bowl and applied to the silk with a sponge, as on leather, and when dry the gold may be laid on, either by drawing the ribbon across the hair to get the necessary grease to hold the gold in place or a little grease pad may be used, as in laying gold on cloth cases.

Care must be taken not to have too much oil on the pad or it will stain the silk. The dye in the stamping press need not be so hot as when gilding powder is used, nor will any difficulty be had in cleaning off the ribbon, as is the case when powder is used. This will be of use in the making of book markers and for the ornamentation of silk generally. It has stood the test of repeated experiments.—Industrial Record.

BLEACHING BLOOD ALBUMEN.

THE contents of a sealed packet deposited with the Mulhouse Society by Persoz ten years ago relate to a method of bleaching blood albumen. When one-fifth of a volume of peroxide of hydrogen is added to one volume of ox blood albumen very slightly acidulated, and the mixture is stirred, a sensible diminution of color is noted, and there is a feeble disengagement of gaseous bubbles, determined, perhaps, by traces of the presence of fibrine. The mixture, left to itself, continues to bleach progressively, and at the end of twenty-four hours has as light a tint as egg albumen. The liquid has then lost all odor of putrefying matter and keeps for some time in contact with the air without showing the least signs of alteration. It coagulates very well and with perfect whiteness at a lower temperature than the serum diluted to the same volume with ordinary water, especially if it is exposed to the direct action of the sun. The state of saturation of the mixture exercises a serious influence.

The bleaching takes place much more rapidly in serum acidulated with acetic acid, and the point of coagulation is then considerably lowered. On the other hand, in the presence of free ammonia the serum bleaches badly and very slowly. The liquid remains of a brownish tint and gives off a bad smell. When, instead of one-fifth of its volume, half this quantity of peroxide of hydrogen is added, the bleaching still takes, but very slowly. Nevertheless, after forty-eight hours, it is sufficiently advanced to render the product capable, in the opinion of Persoz, of taking the place of egg albumen in textile printing.

The commercial peroxide employed by Persoz contained a little free hydrochloric acid and a good deal of sulphuric acid. It was, therefore, necessary to saturate it in advance. In his experiments he neutral-

ized it almost completely with ammonia, then added a little acetate of ammonia in order to preserve a slight acid reaction, but one due to acetic acid alone. In practice it would be useful, doubtless, to eliminate the sulphuric acid from the peroxide of hydrogen by means of baryta, to avoid the introduction of a large quantity of sulphate of ammonia into the serum.

Another method which is considered as valuable as the one propounded by M. Persoz consists in dissolving the blood albumen in tepid water, then setting it in motion in a pan fitted with stirrers and letting it run for two days, adding two gallons of turpentine, at about a pint at a time, during the period it is in motion. By this method bright pigment shades, including ultramarine blues, pinks, violets, heliotropes, etc., are said to be produced equal to those produced by egg albumen.—Industrial Record.

A NEW OZONIZING APPARATUS.*

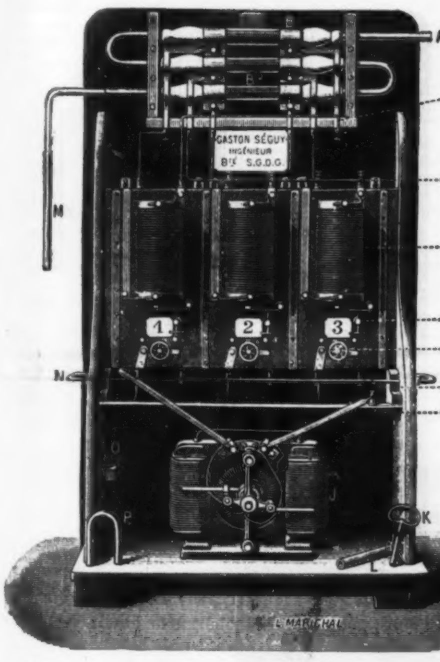
By GASTON SEGUY.

I HAVE the honor to present to the Academy of Sciences a new ozonizing apparatus based upon the principle of tubular machines and designed for industrial, sterilizing and therapeutical applications.

I have endeavored to reduce the bulk of the apparatus and to increase the production of the gas in a large measure.

It results from a study of ozone gas that I have been making since 1885 that its production depends (1) upon component surfaces; (2) upon the interposition of any body whatever between the poles of an electric current; (3) upon the thickness of such interposed body and its conductivity; (4) upon the space that separates the two poles; (5) upon the electric tension employed with respect to the resistance of the circuit; (6) upon the pressure exerted upon the medium of transformation; and (7) upon the temperature at which one operates.

In varying all these conditions in different proportions and bringing them into play in the same action,



A, B, C. Tubular ozone generators. M. Inlet for the gas to be ozonized. A. Outlet. Each generator contains seven narrow tubes open at each end, with internal and external aluminum spirals. The internal spirals are united in one wire which projects from the generator. The same is the case with the external spirals, which are more compressed. Each generator is connected through two wires with the two poles of a bobbin (1, 2, 3) actuated by a dynamo, battery or accumulator.

we obtain the maximum of production of ozone gas.

The following are the results of some quantitative analyses of ozone obtained under the direction of Dr. Roux, by Mr. Marmier, preparator at the Pasteur Institute, by means of the Seguy apparatus.

OZONE OBTAINED BY THE PASSAGE OF AIR.

Volume	1 liter	Pure ozone, 17 mgrs.
Temperature	4° to 5°	
Time	4′	
Discharge	8 amperes	
Transformation	30,000 volts	
Mean obtained per hour	170 mgrs.	

All things equal, save the discharge in amperes less than 8, the apparatus has given from 1·3 grammes to 2 grammes, per horse power.

OZONE OBTAINED BY THE PASSAGE OF OXYGEN.

Volume	1 liter	Pure ozone, 63 mgrs.
Temperature	2° to 6°	
Time	30′	
Electromotive force	6 volts	
Discharge	8 amperes	
Transformation	30,000 volts	

Upon increasing the velocity of the discharge, that is to say, of the passage of the gas submitted to the silent discharge, there may be obtained 250 milligrammes per hour, giving a mean of 56 milligrammes per liter.

Hollow Crystals.—In the American Journal of Pharmacy Mr. L. F. Kebler describes hollow tubular crystals of monobromated camphor which were obtained from a benzin solution. Such a form of crystallization is almost unknown, the interior of the crystals being filled with the mother liquor. Prof. Pettee, in charge of mineralogy at the University of Michigan, to whom some of the crystals were sent, stated that the specimens were without parallel.

* Presented to the French Academy of Sciences, May 18, 1896.

THE ELECTRIC CURRENT OBTAINED DIRECTLY FROM CARBON.

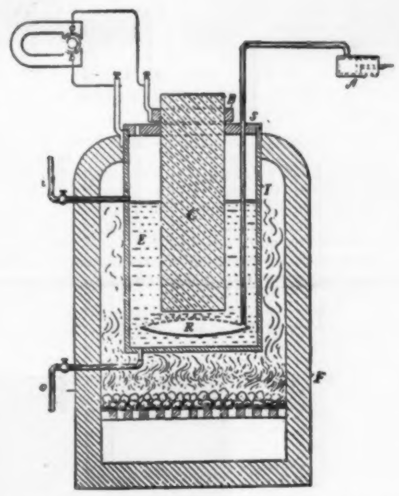
THE subject of the direct conversion of the energy of carbon into electric energy without the intervention of the steam engine is one that has engrossed the attention of certain investigators for a long time. Among the more or less satisfactory solutions of the problem that have been proposed, that which is the subject of a patent granted to Dr. Jacques, of Newton, Mass., by the United States Patent Office, appears of interest to mention.

According to Dr. Jacques, if oxygen, either pure or diluted, as it is found in the air, be made to combine with carbon or material having carbon as a base, not as it does in ordinary combustion, but in causing an electrolyte to intervene, the potential energy of the carbon may be directly converted into electric energy instead of into heat.

The practical method employed by the inventor to effect this result is as follows:

He immerses a carbon cylinder in a solution of caustic soda and forces a current of air to traverse this liquid in such a way that the latter shall retain a quantity of oxygen greater than that which it normally contains. In connecting the solution of caustic soda with the carbon through a non-attackable electrode and an external conductor, a current is established from the soda to the carbon. The intensity of this current depends upon the rapidity with which the air passes into the electrolyte, and, consequently, upon the activity with which the oxygen of the air combines with the carbon.

The arrangement devised for carrying out the process is represented in the accompanying figure. The carbon, C, is immersed in the electrolyte, E. A pump, A, forces the air into a rose, R, which distributes it equally through the mass of liquid, which is contained in a Norwegian iron receptacle, I, that constitutes the positive electrode. The negative terminal is fixed to the carbon, C, which is supported by the insulating cover, S. The solution of caustic soda is introduced and drawn off through the tubes, i and o. The whole is inclosed in a furnace, F, that keeps the element at a temperature of from 400° to 500° C.



APPARATUS FOR PRODUCING AN ELECTRIC CURRENT FROM CARBON.

The actions that occur are as follows: The carbon is gradually converted into carbonic acid, which is disengaged in bubbles in the electrolyte and escapes. The solution of soda undergoes no modification, save that mentioned below.

The oxygen of the air alone keeps up the chemical action. The nitrogen, having no affinity for any of the bodies in presence, simply escapes through the liquid.

Although the greater portion of the carbonic acid resulting from the combination of the carbon and the oxygen furnished by the air escapes, a small portion, nevertheless, combines with the soda to form carbonate of the same. This latter, with the ashes of the carbon consumed, progressively, but slowly, renders the electrolyte turbid and diminishes its efficacy. The latter, however, may be maintained by drawing off some of the turbid liquid from time to time and replacing it with an equal quantity of fresh solution. The solution may also be prevented from becoming turbid, and its duration be prolonged by adding to it a small percentage of oxide of magnesium. The oxide combines more readily with the free carbonic acid than with the soda. The carbonate of magnesium thus formed is promptly decomposed into carbonic acid, which escapes, and into oxide of magnesium, whose action is constantly renewed. The oxide of magnesium serves as a sort of vehicle for carrying the carbonic acid out of the electrolyte.

The function of the latter is to effect, electrolytically, the carriage of the oxygen from the air to the carbon, or to effect the conversion of the energy of the carbon into electric energy by electrolytic action. The inventor, therefore, does not appear to have very clear ideas as to the current producing phenomena that enter into play in his apparatus, whose current, it seems, is very intense, but whose voltage is very feeble. Such feebleness of voltage, in conjunction with the inconveniences inherent to all batteries (for it is a question, upon the whole, merely of a battery of a peculiar kind necessitating an expensive heating), is a capital defect. Dr. Jacques' apparatus is therefore far from solving the question of the direct, practical and economical production of electric energy by carbon; but it is based upon a principle that appears to be new, and that opens up a new field of research.—Revue Universelle.

CABLE LAYING ON THE AMAZON RIVER.*

WHEN it had been decided to connect Belem, the capital of the State of Para, by means of a subfluvial cable with Manaos, the capital of the State of Amazonas, a preliminary journey became necessary, during which landing places at the various intermediate stations had to be selected, some reaches of the river explored, as no trustworthy charts exist, and various other details ascertained in order to facilitate the laying of the cable.

This preliminary survey took place in October of last year during the hottest season, when the river was at its lowest; while the cable was laid during January and February of this year, when the rainy season had commenced and the river was rising.

It is extremely difficult to realize the true proportions of this river, but the subjoined comparative table, in which the dimensions of the principal rivers of the various continents are contrasted with those of the Amazon, will help to show the importance of this great system of natural waterways.

With several other large rivers the Amazon shares the fate that its name changes several times during its long course, and that at various times different affluents have been considered to be the true source of the main stream.

Most geographers, however, regard the Maranon as the principal river, a branch of which, called Tunguragua, rises in Lake Lauricocha in Peru in 10° 30′ S. lat. and 76° 10′ W. long.; although the Ucayle, where it unites with the Maranon at Nauta (4° S. lat., 73° W. long.), is quite as important as the Maranon.

Name.	Length in statute miles.	Watershed. Square miles.	Average discharge, cubic feet per second.	Length of navigable waters in miles.
Mississippi...	2,616[1]	1,285,300[6]	675,000	35,000
La Plata.....	2,400	994,900[6]	700,000?	20,000
St. Lawrence.	2,200	565,200[6]	1,000,000[7]?	2,536
Nile..........	3,370	1,293,050[6]	61,500	3,300[3]
Volga........	2,325	592 300[6]	384,000[2]	14,600
Danube......	1,735	320,300[6]	205,900	1,600[3]
Rhine	810	32,600[6]		550[3]
Thames.. ..	210	6,010	2,220[4]	200[8]
Amazon......	2,730[5]	2,229,900[6]	2,400,000	50,000

(1) To source of Missouri, 4,300 miles.
(2) At Saratoff.
(3) Exclusive of tributaries.
(4) At Teddington.
(5) To source of Apurimac, 3,415 miles.
(6) According to Dr. John Murray.
(7) According to Darby, the American hydrographer.
According to Encyc. Brit.

Area of Great Britain and Ireland	120,626
" " British India	1,560,160
" " Brazil	3,219,000
" " Europe	3,790,000

If the greatest distance from the mouth is to decide the question, then the source of the Apurimac, an affluent of the Ucayale, can lay claim to being the origin of the Amazon, rising in Peru in 16° S. lat. and 72° W. long.

Along the whole course of the Amazon, commencing at the foot of the Andes, a network of islands and canals is formed on both sides of the river, as the whole country is almost level, and is consequently inundated during the rainy season for hundreds of miles by the rivers flowing through it. The most notable exception to this general state of things occurs at Obidos, where the whole volume of water is compressed into one channel a little over a mile wide, and said to be about forty fathoms in average depth. A sounding taken opposite Obidos, about a third of the distance across the river, showed a depth of fifty-eight fathoms, measured by a steel wire and Lord Kelvin's sounding machine. As the current of the river averages three knots in the main channel, it is not easy to take soundings by an ordinary lead line; and even with the steel wire an extra heavy weight (33 lb.) has to be employed, or the results are not trustworthy.

Besides the wire sounding machine a submarine sentinel was used on the preliminary voyage, wherever serious doubts existed about a channel through which the cable was to be laid. This apparatus consists of a small winch from which a wire leads into the water and drags at a short distance behind a piece of wood, shaped like an angle iron, in a nearly upright position. The wire is not attached directly to the piece of wood, but to a string kite fashion, and the wood is fitted with an iron foot which, on coming in contact with the bottom of the water, releases one end of the kite string, so that the wood remains attached to the winch wire with one end only. The consequence is that the strain on the wire is suddenly reduced to a very small amount, and the piece of wood appears on the surface of the river. It depends on the quantity of wire paid out how deep the kite or the sentinel floats, and its action is quite trustworthy, so that it is unnecessary to take soundings by the line or by wire while the sentinel is being dragged by the ship. Usually the sentinel was set at five fathoms, and when it struck a bar the ship was stopped, and a series of soundings taken to ascertain the exact depth of water, and the extent of the shallow place.

A further difficulty in sounding originated from the soft nature of the soil, which for the greater part of the Amazon valley is alluvial clay, and allows the lead to sink into it for several feet. In the narrows there appears, however, a bank of hard clay (called Tabainga) which, unfortunately, blocks nearly all the branches of the narrows, and creates bars all along the course of the Tajipuru, the main westerly waterway connecting to the Gurupa branch of the main river. Occasionally the same hard clay forms shallows in the main river, but as a rule the section of all the channels resembles the capital letter U, i. e., the sides are very steep and the bottom flat. In this respect, as in many others, the Amazon differs entirely from the Indian rivers, which build up their beds above the surrounding country, occasionally breaking through their natural banks and seeking a new bed.

* Abridged from a discourse delivered at the Royal Institution by Mr. Alexander Siemens, in Nature.

The Amazon, on the other hand, carries with it only the light clay sediment which forms the soil of the whole valley; and the inducement for the main stream to alter its course is therefore very small, and long straight reaches are the result.

Under these circumstances the largest vessels can ascend the river nearly to the foot of the Andes, but the constantly changing sandbanks at the mouth of the Amazon proper make this approach of the river dangerous, and the State of Para is, for obvious reasons, not over anxious to have the deep channels properly buoyed and surveyed. This forces all the shipping to enter the Para River, and to pass the narrows if the Amazon is the goal of the journey. In doing the latter, the choice for large ships lies between one of the channels (called Furos) with a bar, where it joins the Tajipuru, and a furo (the Macajubim) which has plenty of water, but which winds about in such a serpentine fashion that only ships with twin screws can pass it unassisted.

These difficulties are, however, much diminished during the rainy season, when the river rises to such an extent as to drive all the inhabitants of its banks into the towns, which have been built wherever a natural eminence secured the inhabitants against the flood. Near the mouth the difference is naturally not so great as higher up, where the influence of the tide is felt less; but at Manaos the difference in level between low river and high river exceeds forty feet.

With all rivers carrying sediment the Amazon shares the peculiarity that its immediate banks are higher than the country lying behind them, and thus we have in the rainy season the spectacle of the main river flowing between two banks covered with dense forest, and immense lakes stretching out on either side of these banks. These do not entirely dry up during the remainder of the year, so that the whole of the Amazon valley really forms a huge swamp covered with a most luxuriant forest, which below Manaos narrows to a broad belt close to the main river with prairies, called Campos, at the back of the forest stretching out to the hills, where the forest recommences. In such a country no land communication of any sort can be attempted, as the tropical vegetation and the annual inundations of the rivers destroy everything that man places in the way of the natural forces. By water, on the other hand, the intercourse between all habitable parts of the country is easy and expeditious, since steamers were introduced in the year 1853. Belem, the capital of the State of Para, lies on a branch of the Para River, called Guajara, which unfortunately does not share the characteristic shape of the Amazon and the furos, but forms a rather shallow basin in front of the town.

The first station on the main cable is Breves, the center of the rubber trade of the islands of the lower Amazon, situate in the center of the "narrows."

In Gurupa, the second station of the main line, the inhabitants expressed their joy at being put in communication with the rest of the world by actively helping in the landing of the first shore end.

During an enforced sojourn near the mouth of the Boinasu, in the midst of the most wonderful combination of islands and rivers, the two naturalists, which the British Museum authorities had kindly sent with the expedition, took full advantage of the opportunity to explore the locality in all directions.

In the rubber gathering industry, which is at once the wealth and bane of this part of the world, the implements in use are of the most primitive kind, but the average earnings can easily be three pounds per day during the dry season, and the facility of earning so much money with little exertion makes the inhabitants unwilling to engage in more arduous labor.

A narrow path leads from the hut on the water's edge into the forest from one rubber tree to another, the path eventually returning to the hut. The trees are cut on the morning round, and the rubber is gathered in the afternoon. As soon as it arrives at the hut a fire of oily palm nuts (Attalea excelsa) is lighted, and the thin sap thickened in the smoke. For this purpose a paddle is used, on to which the sap is poured with a small earthenware or tin vessel. The smoke soon thickens it, and a new layer is poured on until the well known flat cakes of India rubber have been formed.

Owing to the rise of the river during the rainy season most of the huts have to be abandoned, and it can easily be imagined how comfortless they are. Nearly all of them are built on piles, and most of them are thatched with palm leaves. There is hardly any attempt made to cultivate the soil, such as it is, but everything is imported. The steamship Cametense, in which the surveying party went out, was laden with cabbages, onions and potatoes, part of which went as far as Iquitos in Peru.

Chiefly owing to this want of provisions, and to the generally careless mode of life, the mortality among India rubber gatherers is very great.

Everything Bates and Wallace have said of this region remains as true as it was forty years ago, and hardly anything new can be added to their description of the general features of the Amazon valley; but the town of Manaos has completely changed its character since it was made the capital of that region in 1853. A town quite European in its features has arisen in the midst of the forest, and to the benefits of rapid transport, to which it has owed so much, there is now added the characteristic lever of modern progress, the annihilator of space and time—electrical communication.

ELECTRICAL power is being applied on a considerable scale in connection with the new floating pontoon dock, which is at present in construction for Smith's Dock Company, North Shields, says the Electrical Review. This dock, when completed, will be one of the largest floating pontoon docks in existence. Eight 18 inch centrifugal pumps will be employed for raising the dock, each pump being driven direct by a separate 60 brake horse power electromotor. Each of the eight motors will be fixed vertically over its particular pump, and will be direct coupled to the latter by means of a vertical shaft, both motors and pumps having vertical spindles. Ball bearings will be employed to support the weight of the revolving parts. It being necessary for the proper working of the dock to have the pumps under very complete control, the switches and regulating gear will be arranged together, so as to be under the control of one individual. The necessary supply of electrical energy will be obtained from a pair of direct coupled plants of inverted double cylinder combined engines and shunt-wound dynamos, capable, together, of giving about 570 electrical horse power when running at a speed of 350 revolutions per minute. The plant has been designed to raise about 8,000 tons of water through the necessary mean head of about 18 feet, this

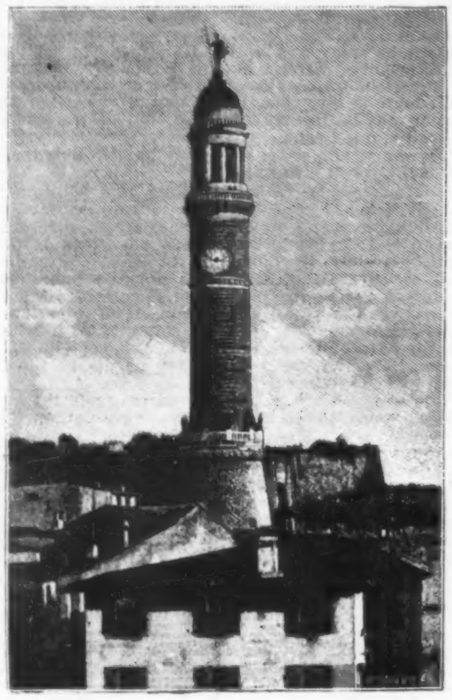


FIG. 1.—THE TORRE DEL POPOLO AND THE STATUE OF SAINT FEDELE.

being the maximum requirement when the dock is fully loaded with a large vessel, in about half an hour. It is believed that no other floating dock in existence can approach this in point of scale and rapidity. The distance between the generating plant and the dock will be about 200 yards, and the electricity will be transmitted at 500 volts pressure. As the dynamos are guaranteed to have a commercial efficiency of 95 per cent., and the motors an efficiency of 90 per cent., while the loss in the cables will be under 4 per cent., the total efficiency of transmission will be high. Further, there will be the advantage that the steam for working the engines will be obtained from existing boilers which do other work, it being obvious that the cost of fuel for boilers devoted exclusively to pumping would be very great, owing to the pumping being done only intermittently with intervals of rest long in comparison with the time actually employed in pumping. The system will probably be eventually extended to an existing graving dock, and another existing floating dock. The engines are being manufactured by Messrs. Belliss, the dynamos by Messrs. Crompton, while Messrs. Ernest Scott & Mountain are supplying the motors, and Messrs. Gwynne the pumps. The whole scheme owes its inception to Mr. Eustace Smith, managing director of the Dock Company, and has been arranged by Mr. A. A. C. Swinton, the consulting electrical engineer, to whose specification the plant is being made.

A STATUE OF ELECTROLYTIC COPPER AT PALAZZOLO SULL'OGLIO.

A COLOSSAL statue of Saint Fedele, obtained by electrolysis, has just been erected upon the Torre del Popolo, at Palazzolo Sull'Oglio.

This statue, which is shown in Fig. 2, is no less than 23 feet in height, while it weighs but 1,760 pounds. Had it been cast in bronze, it would have weighed at least fifty tons. This fact is of great importance, since the statue is placed at the summit of the dome that surmounts the tower, as may be seen in Fig. 1, reproduced from a photograph. It shows once again all the services that artists and architects may derive from the intelligent use of electro-metallurgy.

Palazzolo is situated about midway between Brescia and Bergamo. It is the ancient Palatiolum of the Romans. Its industries, which are very important, and which consist especially in the weaving of silk and cotton, have obtained for it in Italy the nickname of Manchester Bresciana.

Legend has it that Saint Fedele, a bold Roman soldier and one of the first Christian martyrs, dwelt there. That is why this saint is the patron of the city. The Torre del Popolo (Tower of the People), which is one of the finest campaniles of Italy, is so called because it was erected in honor of the saint at the request of the population. It is cylindrical, and this shape was given it by necessity, because it has as a base the largest tower of the ancient fortified castle that served as a defense to the city. It was projected in 1803. A prefectoral decree of January 26, 1804, authorized its construction, and this decree was confirmed seven years later on. A priest named Torrazza was the soul of this popular movement, and all the funds necessary for the execution of the project were raised by him in a short time by subscription. The work was directed by Bessoni, Berenzi, the author of a project for a triumphal arch in honor of Napoleon I, and Giovanni Battista, who designed and constructed the upper part, which is in the form of a Greek temple enriched with a beautiful colonnade and ornaments that were to have been used in another triumphal arch in honor of the great emperor. The cupola was reconstructed at a later period, in a more graceful form, by Arcionni, an architect of Brescia.

The statue of Saint Fedele, placed upon this cupola, was modeled in clay by Mr. Antonio Ricci.

The electro-metallurgic work was done in the establishment of Count Vittorio Turati, at Milan. The skill with which it was conducted does the greatest honor to the engineer who took part in it. The work of the sculptor was first cast in plaster, and the mould was afterward divided into seventeen parts, without counting the accessories, such as the spear, sword and palm. The original work was destroyed.

Each of the parts was metallized with plumbago and placed in the galvanic bath. In order to facilitate the deposit of the copper upon the plaster, a network of wires simulating the form of the surface to be reproduced was placed very near it and fixed to it by

FIG. 2.—VIEW OF THE ELECTROLYTIC COPPER STATUE OF SAINT FEDELE.

(The workmen are represented on the same scale as the statue.)

small pins. The bath was formed of a solution of sulphate of copper. After the first layer of copper had been deposited upon the mould, the wire network was removed. It was left in a few of the pieces, however, and was covered with galvanic copper in order to form an internal armature for the piece itself.

The duration of the operation was ten or twelve days, sometimes more. The intensity of the current was so regulated as to obtain a metal of very great cohesion. The thickness of the metallic layer deposited is nearly 0·2 of an inch. The surface of the statue is about ten square feet. The current was produced by a 600 ampere and 4 to 6 volt dynamo actuated by a 4 horse power gas motor.

It remains for us to give a few details as to the method of assembling the different pieces, and as to the mounting of the statue upon its framework. The whole was so constructed that the entire statue might be shipped and put in place in five different pieces—the legs, the trunk, the head and the arms, without counting the accessories.

These various pieces were afterward united through the superposition of hollow parts and parts in relief obtained directly by electro-metallurgy, and which were fastened by screws. Each of the five sections was formed of two, three or four pieces strongly soldered with zinc and tin.

The different pieces are mounted upon a frame, both very simple and very strong, made of joists. It consists of two uprights that enter through the feet of the statue, that follow the curve of the legs and that extend to the shoulders. These two joists are connected by two cross pieces at the level of the pelvis and that of the shoulders. From the upper cross piece start three other joists that constitute, respectively, the framework of the head and that of the arms. At the level of the waist and that of the shoulders are placed two strong iron hoops to which are fixed two cross pieces.

The framework is prolonged to ten feet below the base of the statue, in order to permit of its being mounted upon the cupola. It was, in fact, necessary to give the whole affair great solidity by reason of the wide surface offered to the wind and of the exposed situation of the tower.

The net cost of this work was much less than if it had been cast, say about a dollar to the pound.

The reproduction of the original work is absolutely perfect up to its least details, as might have been expected from the use of electro-metallurgy. Moreover, by reason of the oxidation that occurred through the prolonged immersion in the acid bath, the surface of the copper took on the proper bronze color. The surface was afterward finished with a metallic patina and boiled oil.

This work shows us all the resources that electro-metallurgy can furnish in operations of this kind. A simple four horse power gas motor actuating a generating dynamo that transmitted the electric current to baths of sulphate of copper sufficed to produce the metallic part desired. It must be remarked, too, that the cost of copper exactly covered all the forms that had been traced.

The artistic aspect of this work is very happy, as may be seen from our engraving. The saint is represented standing. His attitude is simple and energetic and his countenance is pleasant. In his right hand he carries the warrior's spear and in his left the martyr's palm. The dimensions were necessitated by the proportions of the structure.

The difficulties that the execution, carriage and putting in place of the statue would have presented had it been made in a single piece, by the Lenoir process for example, were suppressed by the method of fractional moulding that we have described, and that presents the inconvenience of requiring the use of numerous solderings, but which was the only one applicable in this case.—La Nature.

THE REVOLVING VIBRATIONS OF STRINGS.

THE problem of the vibrating string has for a long time been classical. In fact, it presents the peculiarity of rapidly leading, with few calculations, to approximate results that are easily verified and that are of very great practical importance. It is, moreover, far from being exhausted, either by mathematicians or experiment, and it is not only spikes of grain that are gleaned in this fruitful field, but true clusters that have been left intact by those who have explored it. Mr. A. Cornu, the illustrious president of the Academy of Sciences, has, by a splendid piece of experimental work, just revealed one of those neglected corners that had been passed by unobserved by all those who have occupied themselves with the vibrating string up to the present.

The abnormal sounds that are sometimes given by strings when rubbed with the bow, and that are so vexatious to new performers, have been known for a long time. As long as the note thus produced is higher than the fundamental tone, it is unnecessary to have recourse to any new idea; but the case is otherwise when the sound produced is lower than the fundamental tone. Theory is then at fault, and it is necessary to introduce a new principle into the formulas.

Duhamel endeavored to explain those abnormal sounds in his classical memoir upon the vibrating string, and, at first sight, his theory seems plausible, although somewhat complicated. It is, moreover, a theory very difficult to verify.

The problem had not advanced a step for more than half a century when Mr. Cornu took it up in order to elucidate it completely in attacking it simultaneously by theory and experiment.

Every system of forces acting upon a body is capable of being reduced to one force and one couple. It is in certain peculiar cases only that all the forces are capable of combining in one single resultant. If we examine what occurs in a string actuated by a bow, it at once becomes evident that the latter, acting upon the surface of the string, and not upon its axis, must communicate to it transverse and revolving vibrations simultaneously. These latter are due to the couple existing in the system to which all the forces acting upon the string are reduced.

How has this simple idea been able to escape investigators so long? This is something that will be understood only by those who know how extensively science is strewed with Christopher Columbus' eggs.

It remained to demonstrate these revolving motions and to study them in detail. When it is a question merely of a demonstration experiment, the arrangement to be adopted is extremely simple. There is fixed to the string a piece of cork that carries a small well-balanced disk of cardboard upon which is drawn a radius serving as a datum point. When the string, attacked very freely, gives no abnormal sound, the black line spreads out simply in a band with nearly parallel edges; but as soon as we succeed in producing a strong abnormal sound, the band widens at its extremities so as to form a sort of fan.

This experiment, which is so neat, is unfitted for the precise study of the motion of the string. The moment of inertia of the additional system is too great to be negligible. It introduces into the motion a very appreciable perturbation that may even destroy its nature completely. In order to obtain precise data, it is necessary to operate with an arrangement that is infinitely more delicate. Upon cutting from a sheet of glass, such as is used for object covers in microscopy, a small piece having a surface of a few square millimeters, we obtain an excellent little mirror whose weight does not exceed a milligramme or two, and which may be fixed to the string with a drop of mucilage without fear of introducing any appreciable perturbation into it.

Let us now examine the indications of the mirror. Let us suppose that we concentrate upon it a pencil of light whose axis is at right angles with the string. If it is itself parallel with the axis of the latter, it will reflect the pencil in the flame at right angles with the string containing the source of light. If, now, the string executes transverse vibrations, the mirror will incline from right to left and cause the radius to describe an arc in a plane that contains the vibrating string. The revolving oscillations, on the contrary, will displace the pencil in a perpendicular plane, so that the diagram of the motions of the pencil will,

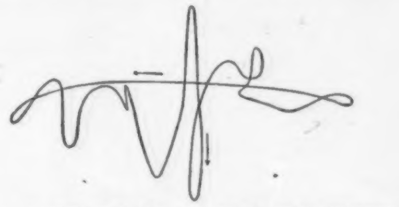


FIG. 2.—DIAGRAM OF THE COMPLETE VIBRATION OF A STRING.

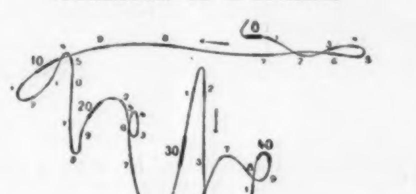


FIG. 3.—THE SAME ANAMORPHOSED BY THE SLOW ROTATION OF A MIRROR.

through its abscisses and ordinates, give the motions of simple vibration and torsion entirely separate.

The luminous point, received upon a screen, describes thereupon a closed curve, which, as a general thing, is very complex. It is strongly compressed in the case of normal sounds, while abnormal ones spread it out above. This curve fully informs us as to the amplitude of the motion of the string in the two directions, but it is inadequate for the complete analysis of the motion as a function of the time. To this effect it is necessary to make use of a cronophotograph process that permits of measuring at every instant the distortion of the string in the two directions. This is done by interrupting the light of the source by means of a disk provided with equidistant apertures. In order to facilitate the analysis of the diagram, care is taken to slightly enlarge one aperture out of every ten in order to mark the tens by a wide line. The photographic diagram then contains all that it is necessary for exactly knowing the whole motion; but if a peculiar artifice were not employed, its analysis would be extremely difficult. In order to facilitate it, there is interposed in the passage of the luminous pencil a mirror to which a slow revolution is given.

Then the curve no longer forms, and its various periods cease to become superposed, and, if care has been taken to draw a preliminary curve in a continuous line that serves to indicate the direction of the motion, we shall have all the data necessary for representing the motion of the string in all its details.

Mr. Cornu's apparatus, which is represented in Fig. 1, is so arranged that the interruptions correspond to ten-thousandths of a second. At this interval of time, the diagram therefore gives a small portion of the motion of the string.

Figs. 2 and 3 give an exact reproduction of two corresponding diagrams. These were obtained with a string vibrating at the rate of 102 periods a second. The point at which the mirror was fixed was near one extremity, while the string was excited very near the other extremity. The curves correspond to the normal

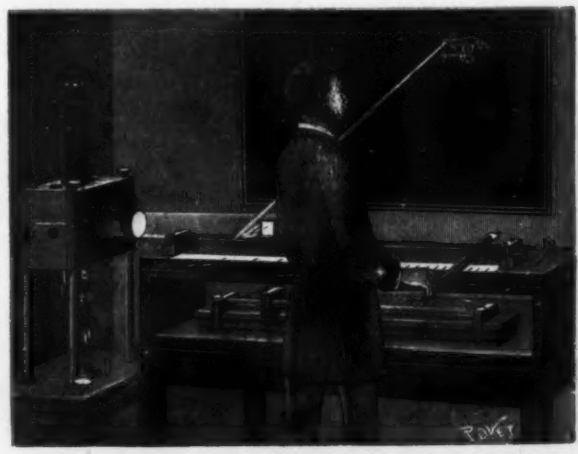


FIG. 1.—MR. CORNU'S APPARATUS FOR THE STUDY OF THE VIBRATIONS OF REVOLVING STRINGS.

sound. It will be seen that, even in this case, the torsional vibrations are of great importance.

The first of these two curves, although very complicated, is exactly closed, and to such a point that it is possible to superpose upon the same diagram a certain number of periods without greatly widening the line traced by the luminous point, provided, however, that the string be attached in a very regular manner.

In Fig. 3 may be seen the general progression of the preceding curve; but the rotation of the mirror has displaced the points to a constant degree, so as to extend the curve above. The trace directly obtained is composed only of small segments marked with a heavy line and numbered from 0 to 55. It is easy, in making use of the first curve, as need be, to unite all the successive traces by a continuous line. It is well, however, to preserve upon the diagram the original lines, which through their successive distances indicate the velocities that the mirror takes in.

The abnormal sounds may be produced at will with a little practice. To this effect, it suffices to bear strongly upon the well resined bow. The parasitic vibrations may then assume so great an importance as to become synchronizing, that is to say, as to impose particular periods upon the transverse vibrations. It is for this reason that these vibrations as a whole, which seem to be entirely independent of each other, give rise to closed curves. The revolving vibrations naturally became very intense in a system of wide diameter and having a considerable moment of inertia along with a feeble moment of torsion. For example, a spiral spring fixed by its extremities gives them with very great intensity.

Musical acoustics is not the only domain in which these vibrations present an interest, for we find them again in a host of problems of elasticity, which will become cleared when such vibrations shall have been made evident.—La Nature.

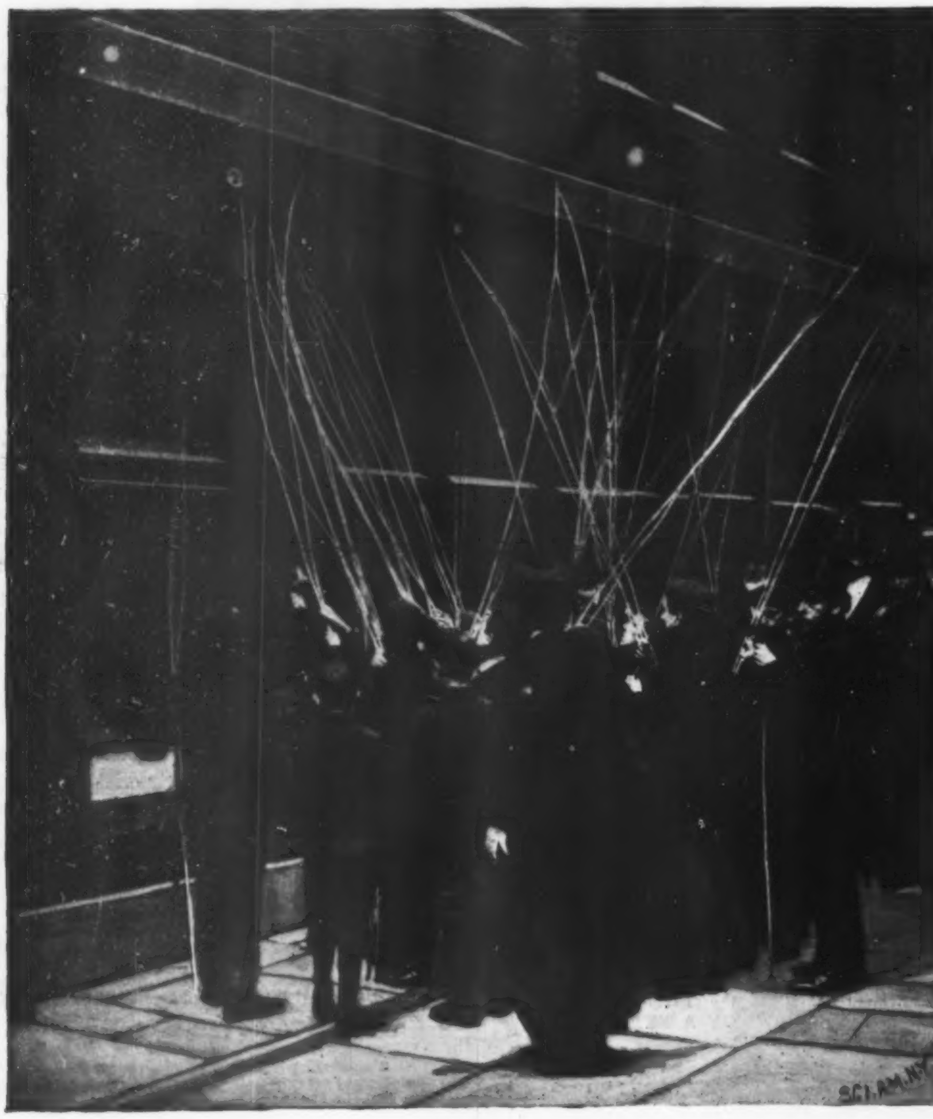
BEATING THE BOUNDS.

WE are constantly confronted in England with the survival of old ceremonial institutions, sometimes derived from old ecclesiastical usages, sometimes from the maze of queer laws which still encumber the statute books. Thus the Christmas season and the Easter season, Ascension and Trinitytide, all have special observances which seem strange to the traveler from beyond the seas. Rogation days are the Monday, Tuesday and Wednesday before Ascension Day. These days were formerly celebrated for their imposing religious processions, but the Church discontinued them at the Reformation. The Rogation days were, however, also called Gange days, from the custom of perambulating the boundaries of the parish on that day, the name being derived from the Saxon "gangen," to go.

Before the Reformation, the processions were most brilliant shows, but when they were forbidden, the useful part of these perambulations was retained. The object of the perambulations was twofold—first, to crave a blessing on the fruits of the earth; second, to preserve in all classes a correct knowledge of and due respect for the boundaries of the parish. The origin of the custom may be traced back to pagan times. After the Reformation the clergymen of the Established Church made the circuit in company with what were called the "substantial men" of the parish. The minister was expected to say the 103d Psalm, and to inculcate the sentence "cursed be he which translateth the bounds and doles of his neighbor." Though it will be seen that there was a certain religious mean-

ing to the procession, the sentiment was certainly not very ethical, and the perambulations soon became colossal parish junkets. At certain parts of the parish refreshments—usually cakes and ale—were provided. In this sole instance was an Englishman's house not his castle, for wo betide the wretch whose house was built on the line of demarkation between the parishes, for in would rush the rabble, according to the time-honored usage. If a canal passed through the boundary, some of the parishioners had to pass it either by swimming or in boats. One house had an oven only passing over the boundary lines. It was customary to put a boy into the oven to preserve the integrity of the line, and the honor of being the lucky boy was eagerly sought. On one occasion the procession found the oven heated up, baking bread; the boy who had drawn the honor for that year made off as fast as his legs would carry him, and another boy clambered over the roof, thus preserving the boundary line. On another occasion, in London, a nobleman's carriage was on the line of march; the coachman was requested to move out of the way; this the flunkey refused to do, unless ordered to by his master. The churchwarden calmly opened one door of the carriage and passed through the other, followed by the rest of the procession.

Little by little the perambulations degenerated. First, the minister ceased to make the tour, then the beadle and churchwarden ceased to attend; so, finally,



BEATING THE BOUNDS IN THE CITY.

the constable was left to lead the procession. But perambulations of the parish have been revived in their entirety in many places, as it is thought that it is a good old time custom. But in this renaissance the religious element is usually lacking.

In the great city of London, even to day, the custom of beating the bounds with long staves exists, and our engraving, from a photograph taken by the enterprise of St. Paul's, shows the curious custom as practiced in that part of London called the "City."

It is to be hoped that the old custom will not die out. It certainly does no harm, and may, possibly, add to the participants' "municipal consciousness." The hard and fast nature of the English parish is, however, very difficult for the American mind to comprehend.

THE GREAT LAKES.

UNITED STATES surveys of the Great Lakes are now quite complete, says the American Woodworker. From these surveys it is shown that the elevation of the mean surface of Lake Ontario above the mean sea level is 246½ feet, that of Lake Erie is 572 feet, that of Lake Huron and Lake Michigan 581 feet, and that of Lake Superior 601 feet. Lake Superior's greatest depth is 1,008 feet and its mean depth 475 feet. Lake Huron has a maximum depth of 750 feet and a mean of 250 feet. Lake Erie has a maximum depth of 210 feet and an average of 70 feet. Lake Ontario has a maximum depth of 738 feet and a mean of 300 feet. The channel of the rivers connecting the lakes seldom exceeds the depth of 50 feet. If the lakes could be drained to the level of the sea, Lake Erie would disappear, Lake Huron would be reduced to insignificant dimensions, Lake Michigan to a length of about 100 miles, with a width of 25 or 30 miles, while Lakes Ontario and Superior, with diminished areas, would still preserve the dignity of their present titles as Great Lakes. Analysis shows no salt in water from the deepest part of Lake Superior. The beds of the lakes are clay in all places where the depth is over 100 feet. Lake Superior water at a depth of 200 feet and more stands at 39 degrees Fahrenheit. The mean annual rain and melted snow deposits in the lake basins are 29 inches in Superior, 30 inches in Huron, 32 inches in Michigan, and 34 inches in Erie and Ontario, or 31 inches for the whole basin. Lake Superior at St. Mary's River discharges 86,000 cubic feet per second, Lakes Michigan and Huron at St. Clair River 225,000, Lake Erie at Niagara 265,000, and Lake Ontario at St. Lawrence River 300,000 cubic feet per second. The volume of water in the lakes is 6,000 cubic miles, enough to supply Niagara Falls for 100 years. Storm waves on the lakes range as high as 18 feet. Small tides are recorded on the lakes. At Chicago there is an amplitude of 1½ inches for the neap tide and 3 inches for the spring tide. There is another class of oscillations called seiches, which have been observed in the Swiss lakes, and for which a solution has not been offered. Whenever the lakes are sufficiently free from the disturbing action of wind to permit observation, a quite regular series of small waves or pulsations can be detected, which have an interval of about ten minutes from impulse to impulse. These pulsations seem to occur almost without cessation on Lake Superior. Over 200 streams flow into Lake Superior, and 800 more flow into the other lakes. These lakes contain over half of the area of fresh water on the earth. The water surface of the Great Lakes, with the land draining into it, presents the total drainage basin of over 270,000 square miles, divided as follows:

	Area Water Surface, Sq. Miles.	Area Water Shed, Sq. Miles.	Ag'te Area of Basin, Sq. Miles.
Lake Superior	31,200	51,600	82,800
St. Mary's River	150	800	950
Lake Michigan	22,450	37,700	60,150
Lake Huron and Georgian Bay	23,800	31,700	55,500
St. Clair River	25	3,800	3,825
Lake St. Clair	410	3,400	3,810
Detroit River	25	1,200	1,225
Lake Erie	9,960	22,700	32,660
Niagara River	15	300	315
Lake Ontario	7,240	21,600	28,840
	95,275	174,800	270,075

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